Madras Agricultural Journal

(ORGAN OF THE M. A. S. UNION)

Vol. XXI] MARCH 1933 [No. 3

CONTENTS

† SOME EXPERIMENTS ON THE CONTROL OF THE ROOT-GALL NEMATODE IN SOUTH INDIA

By P. N. KRISHNA AYYAR, B.A.,

(*Madras Agricultural Department*).

Introduction. The control of the Root-Gall Nematode worm *Heterodera Radicicola*, Gr.* has been the subject of extensive and earnest investigations for the last fifty years in many countries both in Europe and America. Since this worm has been for long recognised as the cause of one of the most serious diseases which crops are subject to, a good deal of literature has arisen and many useful facts have been accumulated on the question ; consequently the problem has advanced to a great extent along many and varied paths of enquiry. One of the

† A paper read before the Indian Science Congress, 1932.

* The correct name for *H. Radicola Greeff* appears to be *Heterodera marioni*, (Cornu, 1879) Goodey, 1932 the specific name *radicicola* being preoccupied by the Genus *Anguillulina* [I. B. A. P., 5, 1932].

most interesting and fruitful lines of research among these has been the increased attention paid to the bionomics of the pest which might provide the key to the problem of its control.

The Nematode is essentially (in the free-living condition) a soil inhabiting organism. The main objective of the studies, therefore, has been confined to the eradication of the pest from infested soil which has been one of the most important and perrennial sources of infection and spread of the disease. The Nematodes are microscopic and cannot, therefore, be tackled in the field. It is also impracticable to treat live plants after infestation. Hence the soil has been the main target of attack and various are the methods devised against the evil effects of the organism among which sterilisation of soil by chemical heat or cultural means has attracted the greatest attention. Numerous experiments in the treatment of the soil by the use of chemicals in solid, liquid and gaseous conditions have been in the past carried out intensively in various parts of the world but the need for further investigation is in no way diminished as no effective, cheap and practicable method of complete eradication of the pest, which can be of universal application, has been evolved yet.

In a previous paper (3) contributed to the Indian Science Congress 1925 the results of the writer's preliminary studies on the subject such as the occurrence of the disease, its nature and symptoms etc. were embodied. Since then the work has been, though intermittently, continued. It is the aim of this paper to set forth the results of the subsequent studies with regard to the range of host plants and distribution in South India, seasonal variations, some resistant varieties of plants, mode of infestation and other related aspects as also to describe briefly some experiments on soil disinfection conducted to bring it under control under South Indian conditions.

Host Plants in South India. The Nematode is abundant and wide-spread in South India and the extent of injury to economic crops is appreciable in many instances. Unfortunately however, no reliable data on these aspects are available in South India although numerous instances of its ravages on a variety of crops have been known from different parts of the province. Since the publication of a preliminary paper on the subject, the Nematode has been observed on an extended range of host plants as well as the extent of its distribution in South India. With a view to present a full account as also to note the new localities where the parasite has been found to occur, a list of plants already known to be susceptible in South India has been advisedly included with a few photographs of infested plants. The list as presented below comprises mostly those noted by the writer and a few recorded by Barber (1). Thus the host range of *Heterodera radicicola* as far as is known has been brought up to date with regard to this country.

New Host Plants Noted in South India.

Scientific name	Popular name
Pisum sativum	Peas
Antirrhinum majus	Snap dragon
Zinnia elegans	Zinnia
Phaseolus vulgaris	French bean
Tithonia diversifolia	Mexican sunflower
Impatiens balasmina	Balasam
Amarantus caudatus	Love-lies-breeding (Crimson)
Amarantus gangeticus	Thandu keerai (Tamil)
Braassica juncea	Mustard
Helianthus annuus	Sunflower
Lactuca sativa	Lettuce
Abutilon indicum	
Cucurbita maxima	
Chrozophora Rottleri	(A common weed)
Musa paradisica	Plantain
Vigna catjang	Cow pea
Cucumis sp.	Cucumber
Dioscorea alata	(Mal. Kachalkilangu)
Cyamopsis tetragonoloba	Cluster bean
Canavalia ensiformis	Sword bean

Host Plants Previously Noted from S. India.

Scientific Name	Popular or Common Name
Capsicum annuum	Chillies
Nicotina tabacum	Tobacco
Canna indica	Indian shot
Curcuma longa	Tumeric
Brassica oleracea (var)	Cauliflower
Brassica oleracea	Cabbage
Apium graveolenes	Celery
Brassica caulorapa	Knol-khol
Daucus carota	Carrot

Host Plants Previously Noted (contd.)

Scientific name	Popular name
Beta vulgaris	Beet
Piper betle	Betel
Piper nigrum	Pepper
Sesbania aegyptiaca	Daincha
Hibiscus esculentus	Bhendai
Hibiscus cannabinus	Gogu
Coleus parviflorus	Koorkai (*Mal.*)
Dioscorea	"
Cucumis sativus	Cucumber
Camellia thea	Tea

Cinchona sp.	Cinchona
Impaticus kleinii	,,
Sida rhombifolia	,,
Triumfetta rhomboidea	,,
Centratherum reticulatum	,,
Emilia zeylanica	,,
Oldenlandia sp.	,,
Desmodium sp.	,,
Ageratum conyzoides	Goat weed
Mullungo pentaphylla	
M. stricta	

Extent of The Disease and Personal Activity. The disease, as may be apparent from its occurrence in very widely different localities, is common throughout South India and it sometime develops into a serious malady causing severe losses. During certain seasons of the year the Nematodes appear to be less numerous and active. As a result of observation for many years it may be noted that in South India these multiply and thrive well in the period extending approximately between the months of August and February although isolated cases of their occurrence may be seen all the year round.

Some Nematode Resistant Plants. In nature among cultiveted crops certain varieties of plants are seen to be comparitively resistant to *Heterodera* as may be evident from the absence of any trace of root-galls in certain plants growing in infested soil. By the cultivation of such plants in infested localities for a few years it has been found that the nematode population in a given plot may be considerably reduced and possibly completely starved out in the course of time. When susceptible crops are scrupulously eschewed and such resistant varieties are persistently grown in the soil, the activity of the worm may continue for some time with the available food in the soil, but sooner or later the store of food reserves will be depleted with the result that worms are slowly killed by starvation. Such beneficial results have been noted by the writer in the course of his limited observations though no systematic efforts in this direction have been carried out. In a plot which was observed to be badly infested, cholam (*Andropogon sorghum*), ragi (*Elusine corocana*), red gram (*Cajanus indicus*) and maize (*Zea mays*) were grown though not by design and these were repeatedly examined to see if they are subject to the attentions of the pest. These have always been found to be free and therefore the writer has concluded that these may be included among the disease resistant crops in South India. In such a plot the most susceptible crops such as knol-khol, tomatoes and other crops have been grown later. On examination of these plants the writer noted that the attack has been generally less severe indicating thereby that the Nematode population of the area has been greatly reduced. It is clear therefore that a systematic and judicious rotation

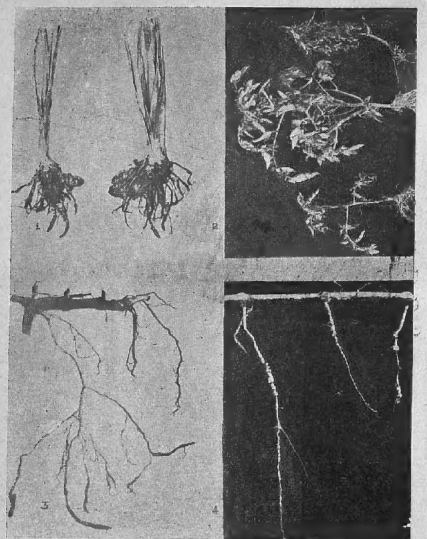

Plate B.

Plate A.

Plate A.

Development and life-cycle of H. radicicola (Greef) Muller. original (all drawn from author's own slides).

1 to 7. Eggs in various stages of segmentation (greatly enlarged).

8 to 9. Young worm coiled inside egg membrane in different stages of growth. (enlarged).

10(a, b, c, d). Various forms of immature larvae.

11 to 14. Various stages in the distension of the larvae.

15 to 16. Young female cyst in different stages.

17 to 18. Female showing genital tubes and ovaries small and large ova.

19 to 20. Male undergoing transformation. (metamorphosis).

21 to 22. Fully formed mature male. (enlarged).

Plate B.

1. Roots of Turmeric (Curcuma longa) infested with *Heterodera radicicola* showing enlargements (original).
2. Tomato plants (Lycopersicum esculentum) showing nature and symptoms of attack by H. radicicola.
   Left—Moderately attacked.
   Middle—Unaffected.
   Right—Thoroughly infested. (original).
3. Betel vine roots (Piper betel) showing enlargements caused by H. radicicola. (original).
4. Adventitious roots of cucurbita maxima (sweet gourd) heavily attacked by H. radicicola. (original).

of such immune varieties like cholam, red-gram, ragi, and maize for a few years may prove an easy and effective method for a gradual elimination of the pest from the soil. But it is doubtful whether such plants will ever remain immune to the attack of worms, especially in the light of reports that some plants considered to be resistant proved to be susceptible later on.

Some Control Experiments. *The Experimental Plot and Host History*: Various measures of control against these plant-parasites have been recommended, but the efficacy of none has been proved under South Indian conditions. Hence some experiments including a few chemical treatments of soil were planned to be carried out in the Botanical gardens attached to the Agricultural College, Coimbatore. Before embarking on a description of the experiments it may be of interest to record the spread of this disease in this garden in view of the emphasis laid on a knowledge of the host history of the particular strain or population of Heterodera experimented with. Although the presence of this pest was known by isolated cases of occurrence the writer ventures to suggest that this pest was first discovered by him in the garden about ten years back in cauliflower roots. How long prior to this period the parasite has been in the garden soil or how it has gained entrance are only matters of conjecture as the organism is a stealthy foe. The spread of the disease in the garden and the variety of plants attacked later on may have a bearing on the history of host selection and specialisation, a study whose significance has been markedly brought out by Steiner (4). It is noted that it spreads rapidly and its progress cannot be easily arrested. From a knowledge of its life history (*Vide* life history plate) the pest is noted to be prolific, each female being capable of producing about 500 eggs and of undergoing nearly ten generations a year. It may be noted here that the mechanical injury caused to the plant tissue by "mouth spear" is probably insignificant compared to the toxic effect produced by their salivary secretions. The reaction set up by the latter coupled with that of their excreta may be the real cause of the development of the galls so characteristic of the affection. To follow the course of its progress provides interesting reading. From cauliflower the parasite soon extended its range to its near allies such as cabbage, knol-khol, carrot, radish etc. in a few months. A little later it began to show its preference to tomatoes grown in the neighbourhood as was evident from the numerous large galls on their roots. After a season brinjals suffered badly by their attentions. These plants grown in a fairly large plot were heavily attacked without any exception. The ravages of the pest on these plants accentuated the need for control measures. Subsequently crops like peas, amaranthus and various ornamental and flower plants like balsam, sunflower etc. suffered in quick succession in varying degrees.

Favourable Conditions and Means of Dissemination : The raid increase of the pest and the widening of the range of host plants naturally led the writer to investigate the conditions favourable to its multiplication and dissemination. The soil in the garden is most conducive to its prolonged life and activity being a sandy and porous loam of loose texture with sufficient moisture. In contrast to this they are not so abundant in other portions of garden as has been gathered from the degree of infestations in plants in portions of garden having heavy clayey soil or in spots which are sometimes either waterlogged or completely dry. Coupled with these conditions there is a constant and uninterrupted supply of food in the gardens. In short, all conditions and practices conducive to better and intensive farming such as irrigation, good drainage, etc., all appeared favourable to the growth and multiplication of the organism.

As to the means of the transmission of the nematode to fresh localities, observations indicate that the main cause is to be traced in this country to heavy rains and consequent flow of water from place to place. Irrigation, of course, forms an important means of infestation. To a certain extent the transportation of movables—such as agricultural implements, manure heaps from infested soil, affected roots of live and dead plants, are also potent causes of its spread to different localities. Animals and man treading infested and free soils also help the transference of the pest through the moist soil clinging to the limbs. Fortunately, by its efforts the parasite is known to move for only short distances within a few feet, which adds additional proof to show that the main causes of dissemination are those detailed above.

Treatments. This heavily infested garden soil afforded an ideal ground for the conduct of these experiments. Beyond doubt the soil was literally alive with Heterodera. The experiments were actually commenced by the end of the year 1924 and continued up to the beginning of 1926. A strip of ground sufficiently large in extent was divided into rectangular areas of 5 x 4 feet and each plot was isolated from the rest by means of four broad wooden plants sunk to a depth of a foot and a half into the soil along the sides of the plot. This resulted in a box-like arrangement for each of the fifteen plots. Five of these plots were reserved as controls. Two were kept for partial sterilisation and trap-crop. Each one of the eight remaining plots was treated with one of the following substances, the rate, the number of treatments and the intervals between treatments being as indicated below. The soil in each plot was saturated with the required quantity of solution after ascertaining the same by actual trial with small samples of soil.

Substance	*Proportion*	*No. of treatments and intervals*
Carbolic acid	1 in 15 parts of water	three times with an interval of 9 days between treatments
Kerosine	2 gals. for the whole area	once
Formalin	1 in 25 parts of water	do
Potassium cyanide	200 lbs. per acre	Two treatments with an interval of 8 days
Carbon bisulphide	4 oz. per sq. yard	once
Lime	27 lbs. for whole area	do
Sulphuric acid	1 in 80 parts of water	do
Ranicide	½ oz. per sq. feet	do

Partial Sterilisation : The soil in one plot was sterilised by burning cholam stalks and other materials ; then it was loosened and spaded at intervals. The process was repeated thrice with an interval of two days between treatments.

Trap Crop. As suggested by Kuhn the method of trapping the worms by growing a very susceptible crop along with the valuable crop and uprooting and destroying the "catch" or "lure" plants in time before the worms have begun to emerge from the roots and reinfest the soil, was given a trial in one of the plots. Hence one of the cruciferae namely *knol-khol* was grown along with the test crop.

Sowing and subsequent observations. Various lengths of time had to be allowed to elapse after each treatment before the planting of the test crop, and the treatments themselves were so timed as to allow planting of all plots simultaneously. Accordingly all the plots were sown with peas on 10—2—25 but as peas failed to grow well brinjal plants grown in free and uninfested soil elsewhere and found to be free from elworms after examination were planted. These plants were found to grow well though not very vigorously. After the lapse of about one month, one plant from each plot was dug up with roots intact and examin d. Thereafter periodical examinations of the plants from the several plots was continued for several months. The results of the examination can be roughly expressed as follows:— The plants from the control plots invariably showed a heavy infestation compared with those in the experimental plots. Those in the experimental plots exhibited different degrees of attack which is very difficult of interpretation. The plants from carbon bisulphide plots showed a doubtful infection and plants from kerosene plot showed infestations more or less similar to the controls indicating thus the other extreme and the utmost that could be done by a very wide stretch of the results is to group the other treatments into three or

four categories between these extremes. Those that are grouped together showed no marked differences in the degree of infestation as noted from the galls produced. But yet the writer feels that the effects of the different treatments may approximately be expressed in the following manner arranged in the descending order of severity of attack:—

Kerosene—More or less severe attack having many galls.

Sulphuric acid
Ranicide
Carbolic acid
Pottassium cyanide
} Not so severe—fewer galls.

Partial sterilisation
Trap crop.
} Mild—a few galls.

Formalin Lime } Slight—(There were galls).

Carbon bisulphide—Doubtful attack.

Although these observations were continued for a long time no further comparisons could be made as all plants in some plots died. In November 1925, the plants in carbon bisulphide plot were seen to have clearer infestation showing that this plot also has not escaped the attentions of the Nematode.

Interpretation of Results. The microscopic and other examinations of the plants in the different treated and control plots from time to time and a comparison of the same as far as possible did not lead to any definite conclusions as was anticipated but it must be admitted that these served to throw light on the intricacy of the problem in question. It was not possible under the conditions of the experiment and the unexpected difficulties and complications that cropped up in its course to calculate the percentage of attack or accurately demonstrate the relative values of the chemical heat and trapping treatment by reliable data or concrete figures. The best method of expressing results would be a comparison of respective yields but under the circumstances that was obviously out of the question. It was only possible in an approximate and empirical manner to estimate the extent of infection and express the effects of treatments in terms of degrees as severe, medium, and mild or slight. It was even difficult in some cases to differentiate the degrees of infestation in certain treatments and hence these have been grouped together as having more or less similar infestation. Certain facts have however been brought to light as for instance that *all treated plots with the exception of kerosine were generally better than the controls* as seen not merely from the less severe attack but also from the time taken to develop the galls in a few cases. It can also be seen that the effect of the various treatments continued to last though in diminished extent for varying periods ranging from two months to six months.

To be more precise, as infestation occurred both in control and treated plots though in the latter in varying degrees of severity it may be safely concluded that none of the treatments have been effective in the complete eradication of *Heterodera*. The treatments, at least some of them, certainly caused a reduction in the population of the worms in the treated soil for the time being as shown by the diverse degree of infection and varying lengths of time taken to produce the characteristic galls. It is also evident that within a short time i. e., a few months, the Nematode is able to restock the treated plots with the normal population. Evidence then indicates that such sterilisations of soil by treatments can only be of temporary benefit and the relief obtained lasts only for a few months, the period of duration of such a beneficial condition, varying with different treatments and probably also with different concentrations of the same substances. Hence such treatments can be utilised to minimise damage to valuable crops which under the circumstances, *is not a mean* achievement.

The other causes of a partial failure of the experiments were inherent in the methods of control themselves. The first and foremost cause under this category that suggests itself more prominently than others is that, since the several plots were more or less well isolated, the worms or eggs were not completely killed by the treatments either because they were hardly enough to withstand the effects of chemicals etc., or they were at depths beyond the reach of the application. Another probable reason for their presence may be that certain stages in their life are such as to have some means of protection against adverse effects.

The investigations by Godfrey (2) in regard to the depth distribution of *Heterodera radicicola* clearly show that these are distributed in the soil in varying depths according to the conditions of soil, season and availability of moisture, etc., and the efficacy of any treatment is to be judged by the depths to which the treatments can extend their influence. Hence to determine the depth to which the treatment has to be extended, it is necessary to make a study of each locality in regard to the Nematode content of soil at varying depths in different seasons. This is one line of investigation which requires urgent attention if any success is to be had in the control of these worms.

In order to see whether the eggs or larvae of these worms in the soil develop any protective structure while in the soil, so as to withstand any adverse effect of heat or chemical, it is necessary to know more about the life history of the worm in the soil. All that is known is that larva is unable to develop beyond the larval stage until it gains access into the root of a host plant, and then passes through several stages in the root and ultimately develops into a male or female as the case may be. But so far as the writer has been able to gather from

literature on the subject none of the previous workers have directed their attention to the possibility of the young worm remaining in the soil for long periods in a slightly different condition from the one supposed to exist.

Other Methods of Control. Various other methods of control are being tried in other countries among which the breeding of Nematode resistant varieties of plants is a very promising field of investigation. Another method which has been suggested but not demonstrated to be effective, is that known as biological control whereby a voracious species of Nematode *Monnonchus. papillatus* is sought to be utilised, for exterminating Heterodera on account of its predaceous instinct. Flooding the infected portions of fields with water for a week or two, and drowning the worms has been recommended but it is not always practicable. Hot water treatment and steam sterilisation of soil have been reported to be effective in the case of limited areas of infested land.

Conclusion. The experiments described in the paper although unfortunately few in number and inconclusive in results, may, it is hoped, serve at least the purpose of bringing into prominence the serious. nature of the problem in South India as also the various factors which have to be taken into account in devising control measures and the unexpeted developments that have to be guarded against in the course of trials. The foregoing paragraphs may also serve to show how little is known of this serious pest in India and that the problem, though not easy of solution, affords a highly promising field for exploration. Sufficient, it is believed, has been said to induce interest in the subject and to indicate the lines along which further investigations may profitably be accomplished and the writer will feel more than satisfied, if by these attempts, the problem has been brought any the nearer of solution. Opportunity is taken here of expressing the writer's deep indebtedness to the Govt. Entomologist, M. R. Ry., Rao Sahib Y. Ramachandra Rao Garu, and to the Principal, M. R. Ry., C. Tadulinga Mudaliar Avl., for affording facilities for the investigation and to all those whose writings have been drawn upon in preparing this paper. The writer's most sincere thanks are tendered to Dr. T. V. Ramakrishna Iyer for his unfailing kindness and encouragement in this as well as similar studies.

Note:—Since presenting this paper for the Indian Science Congress the writer had an opportunity of seeing (by the kind courtesy of Col. A. Olver, C. B. O. B. E., etc., of the Imperial Council of Agricultural Research in response to writer's request) a monograph on " the Root-infesting Eelworms of the genus Heterodera " published by the Imperial Bureau of Agricultural Parasitology, London (1931) which gives an up-to date and exhaustive list of host plants so far noted all over the world together with a complete list of Bibliography the value and usefulness of which can never be over estimated for workers in this field. It is obvious that the writer could have saved much time and labour had he come across this important publication before the preparation of this paper especially in the matter of hunting up the scattered literature on the subject.

Literature Cited

1. Barber C. A. (1901)—A Tea Eelworm in S. India—*Madaas Bul. 45.*
2. Godfrey G. H. (1926)—The Depth distribution of the Root-knot in Florida soils. *Jour. Agri. Research.* Vol. XXIX. No. 2. pp. 93—98.
3. Krishna Ayyar P. N. (1926)—A preliminary note on the root-gall Nematode, Heterodera radicicola and its economic importance in S. India. *Madras Agri. Jour.* XIV. p. 113—118.
4. Steiner G. (1925)—The problem of host selection and host specialisation of certain plant infesting nemas—*Phytopath XV pp.* 499—534.

† NATIONAL WELL-BEING & AGRICULTURAL IMPROVEMENTS

By M. ANANDAN, L. Ag.

Superintendent, Agricultural Research Station, Aduturai.

We have, in common, with the rest of the world, been passing through an unprecedented economic depression for the past two years. Following, as it did, on the heels of post-war years of high prices and apparent prosperity, the effect of the depression seems to have been magnified more than it would have appeared under normal pre-war conditions. No two economists are agreed either as to the real causes for the depression or with regard to its remedy. Some say that it is due to over-production of commodities more than is justified by world demand, some say that its cause is to be traced to reparations and war debts, while others say that it is due to the combined effect of world-wide over-mechanisation of the means of production resulting in unemployment of man and animal labour and the natural increase of world's population. It seems to me that all the above factors either singly or in combination have contributed in varying degrees to the present depression. It is reported that the International Statistical Institute estimates that between the years 1920 and 1928, 125,550,000 had been added to the world's population. The Indian contribution to this increase has been in the neighbourhood of 25,000,000. The remedies suggested for getting over the economic ills of the world are also of various kinds, removal of tariff walls, organisation of exchanges on a new basis like the bartex sponsored b. the London Chamber of Commerce, 'Erne' proposed by Dr. Fowler in India, actual barter of commodities between nations as the exchange of American wheat and cotton for Brazilian coffee, and Russian petrol for Egyptian cotton and international agreements imposing restrictions on the production of commodities like sugar in Java, Cuba and Europe, rubber in Dutch East Indies, Malaya and other rubber producing countries.

† Paper read at the Agricultural Conference held under the auspices of the Trichinopoly District Agricultural Association at Srirangam on 4th January 1933.

While over-production and over-mechanisation may be the causes for the unemployment and economic depression in other countries of the world, India's ills, on the other hand, have been, in normal times, and are to a great extent, even in this period of depression, due to under-production and non-mechanisation, particularly of its basic industry of agriculture. Under-production and over-population, I believe, have combined more than anything else to keep down the standard of life of the average Indian. In other words, the cost of production per acre of any staple crop in terms of its yield is so high in India, that countries not so well placed as India as regards climate and soil for crop production have been able to dump their produce on the Indian market and even to threaten to oust the indigenous produce in this competition. Australian wheat and Java sugar are examples. These countries have been able to do so by the application of scientific knowledge and methods for higher crop production and cutting down cost all along the line by efficiency in operations. To make the point clear, I may tell you that Java produces on an average, 65 tons of cane from an acre while India's average is about 35 tons from the same acre. We, at the same time claim, that India has the largest area under sugarcane and suitable for its cultivation. What lee-way we have yet to make, to come on a par with Java in this respect, needs no stressing from me. The same case holds good more or less, in respect of all other crops that enter into competition with other countries in the world's market.

Coming nearer home, we have the case of Tanjore rice unable to compete with that of Burma or Indo-China in the Ceylon market for the same reasons, as amply proved by Mr. N. S. Kulandaiswami Pillai, the Deputy Director of Agriculture of this Circle, in his recent report on his enquiry into the prospect of Tanjore rice in that island. A reduction of a rupee in the cost of production, or an extra yield of a rupee from every acre of paddy in the Tanjore Delta, would mean a saving of a million rupees every year. If the mirasdars of Tanjore owning this million acres of rice fields save this amount in a year, they may charter a steamer of their own and transport their rice more cheaply to Ceylon and the West Coast.

So anything made to raise the standard of production of Indian agriculture means simply the raising the standard of life of 75 % of the people of India, and indirectly that of the remaining 25 % of the population also, as almost all the other industries in the country derive their strength from this basic industry. India is forging ahead with other industries in a remarkable way now, and as more and more industries get established, to that extent, we may foresee that many millions now engaged in agriculture would be diverted to such industries. This diversion should be welcomed as it would, in addition to relieving the undue pressure of population on land surely stimulate

and strengthen the industrial outlook of the people and make them more industrially-minded than they have been in the past. But this diversion of agricultural labour to industries will have consequences of far-reaching effect on the traditional methods of production employed in agriculture. One sure result would be the use of more and more labour-saving and efficient implements in crop production, in other words, mechanisation of production to an appreciable extent, though not to the extent of managing a 1000-acre farm by a couple of men with the help of machinery. Such drastic mechanisation is not generally adaptable to Indian conditions and even if possible, does not seem to be desirable. This partial mechanisation would be enough to create a huge industry of agricultural implement manufacture. There should be many more Kirloskar Brothers to cope with the demand. This solitary example is enough to show what healthy reaction, agricultural development on improved lines will have on the industries of the country.

The first concern of agriculture should, of course be, to produce a sufficiency of food crops to support the huge population of men and domestic animals in the country. This itself would task the resources of the agricultural industry to a great extent and more than this, the demand of industry for raw materials in sufficient quantity, and of high grade in quality, would be certain to increase as years go on. This means, again, adoption of all possible methods of production, and production of commodities of the highest grade in quality. Let me now briefly touch upon the various methods that we can adopt for improving the productive capacity of our soils and crops.

Soil management itself is a problem of such vast magnitude and importance that no *mirasdar* can ignore it if he is desirous of getting profitable returns out of his land. The land should be laid out in proper way for facilitating irrigation, and still more, its drainage. Neglect of draining fields at the proper time has caused, in many a case, utter failure of the crops grown on them. Most destructive diseases of crops also appear when this operation is neglected. Red-rot of sugarcane is a typical instance.

Cultivation of soil at the proper time and with the suitable implement, is of such vital importance to the growth of crops that the fact cannot be over-emphasised. This fact, though known to many, is not generally adopted. It is easy to imagine that, as the roots of plants are the real organs concerned in gathering nutritive materials for building up a plant from the soil, all facilities afforded for their easy spread in the soil in all directions will be reflected in the final produce from a crop. That this is the result has been amply proved by the increased yield of paddy, cholam, cotton and other crops obtained by deep ploughing with improved iron ploughs. An increase

of two *kalams* of paddy per acre is a certainty by the adoption of this improvement suggested by the agricultural department.

Seed rate. The adoption of a higher or lower seed rate than is normal for a crop will pull down its final yield. It has been amply demonstrated that, in the case of paddy, *mirasdars* are using at least double the seed rate that is required for raising a normal crop. Ryots generally use 36 madras measures per acre in the case of *kuruvai* and 24 madras measures in the case of *samba*, while the department advocates only half of this as more than sufficient for planting an acre. There are 11 million acres of paddy land in this Presidency and a universal adoption of this seed rate for paddy would result in a saving of at least 5½ million rupees even in these days of low prices for paddy. It is really a criminal waste if we realise the fact that more than 150 million madras measures of paddy are thrown away in the fields when it would have fed a million people for more than 6 months.

Manuring: When we harvest and sell a crop off a field, it means that we have impoverished the soil to that extent. So, if we are to maintain and increase the crop producing capacity of a soil, we must put back the plant food removed in the shape of crops, through suitable manures. Different crops require different combinations and quantities of manures. So great care will have to be exercised in the choice and dose of manures given to a crop. It has been proved by actual experiments that crops respond, under South Indian conditions, to the application of phosphatic and nitrogenous manures when given in combination with organic matter. A net increase of at least 2 *kalams* of paddy is quite possible by the adoption of the manurial combinations and doses advocated by the department.

Use of improved strains of seed: Anything from 10 to 25 % increase in crop yield is possible by the use of improved strains of seeds of various crops evolved at the Agricultural Research stations in the Presidency. The paddy strains evolved at the Agricultural Research station at Aduturai, have replaced the ordinary varieties in more than 2 lakhs of acres in Tanjore and Trichinopoly districts. And it is only a question of a few years more, before the whole area under paddy would be planted with improved strains in these two districts.

Rotation of crops: Wise rotation of crops is a great necessity both for the maintenance of soil fertility, as well as for avoiding the risks resulting from relying on a single crop, in times of depressed prices. It is always a sound plan "not to put all your eggs in one basket". The lesson that the Malaya rubber planter and Tanjore rice grower have learned in this regard is a sufficient warning for all.

Side lines of agriculture like dairying, poultry-farming, bee-keeping, and fish breeding should as far as possible be combined with agriculture for greater profits.

Reducing cost of production is another method that can be adopted for successful farming. This may be achieved in various directions. It is, indeed a question of farm economics. Practical methods for adoption are (1) the better preservation of cattle manure, (2) conversion of all waste products into composts for use as manure, (3) use of efficient implements, (4) cutting down maintenance and feeding charges by using fewer and better type of animals for agricultural purposes.

Preparation of produce for the market and its transport are other directions in which enormous improvement is possible in Indian agriculture. Take for instance the case of plantain grown extensively in your district. As it is an extremely perishable product and as the crop comes on the market all at a time, the price of fruit falls to an alarming extent, to make the cultivation of this crop almost an unprofitable business. There are two ways of getting over the difficulty. One is speedier transport of the fruit to North Indian markets, perhaps, under cold storage. In this direction, the Director of Agriculture is personally interesting himself and I understand, has an idea of taking a representative of the Trichinopoly Plantain Growers' Association to North India with him for studying the market facilities there in co-operation with the Agricultural departments of the various North Indian Provinces.

Another direction in which I am trying to solve in a small way this problem of slump in plaintain trade is by trying to convert plantain fruits into ' figs ' by sun-drying the fruits under proper sanitary conditions. Plantain figs of excellent quality and flavour are now being made on the Agricultural Research Station at Aduturai. The dietetic value including the vitamin content of these figs, will be tested shortly. From the figures so far gathered, I find that a 100 lb. bunch of plantain when dried gives 15 lbs. of fig and that well prepared figs keep well for more than a year. From the above it is clear that we can reduce considerably the freight on fruits by marketing them as figs and also regulate the supply throughout the year. It would also enable us to send the product to foreign markets. Plantain fig making can be easily introduced as a cottage industry. The precautions to be taken are that the fruits will have to be dried under fly-proof conditions and that no attempts should be made to make figs during damp and cloudy weather, as they easily get mouldy under such conditions.

In conclusion, I assure the mirasdars of Tanjore and Trichinopoly that no improvement is advocated by the department for adoption that has not been put to rigorous tests on the Research stations and request them to make use of those improvements for raising the level of crop production in this country.

TOMATO OR LOVE APPLE

BY K. K. RAGHAVAN, L. Ag. (Hons).
Farm Manager, Central Farm, Coimbatore.

Introduction. Of all vegetables that have recently come to the forefront, Tomato (*Lycopersicum esculentum*) must be given a very prominent place. It is the cheapest and most easily grown vegetable and a very valuable fruit from a nutritional view point. It contains vitamins A, B and C in plenty and is one of the richest sources, of these. This paper is only an attempt to record in brief outline, some of the observations made and experience gained during the last two years, when the writer was privileged to be in charge of the orchard and vegetable garden in the Central Farm. As the value of vitamins in human and animal nutrition becomes increasingly known this fruit is bound to come to greater prominence. It is both a fruit and a vegetable and since it can be eaten raw, the vitamins contained in it are not lost. The analysis of the fruit as determined by the Government Agricultural Chemist is interesting.

Results of analysis of Tomato for its food value.

Heads of analysis	Tomato (raw)		Tomato (ripe)	
	% on dry weight.	% on green weight.	% on dry weight.	% on green weight.
Moisture	...	95·48	...	93·61
Ash.	14·07	0·64	16·92	1·08
Proteids	21·20	0·96	24·35	1·56
Ether extractives	6·40	0·29	6·40	0·41
Fibre	12·68	0·57	14·79	0·95
Carbohydrates	45·65	2·06	37·54	2·39
	100·00	100·00	100·00	100·00
Insoluble mineral matter.	0·15	0·01	0·17	0·01
Albuminoids	15·77	0·71	18·44	1·18
Phosphoric acid	1·22	0·06	1·38	0·09
Potash	6·54	0·30	7·44	0·48
Lime	0·31	0·01	0·33	0·02

From the above table it is apparent that the tomato contains a high percentage of moisture at all stages. It is high in protein and hence of great value as a food. It is also low in fibre and hence easily

digestible. It is high in ashes and contains a large percentage of phosphoric acid and potash. It is deficient in lime. The food value also increases as the fruit ripens.

The cultivated tomato of to-day is a native of Tropical America. It has undergone a series of changes before it attained the present level of perfection.

Soils. It can be easily grown on all types of soils. But on a rich sandy loam with good facilities for drainage it yields best. Under conditions obtaining in Coimbatore there is no particular season during which alone it can be grown. Irrigation is the chief limiting factor. During the hotter months of the year, however, it may be somewhat difficult to get the plants established but when once they get established, they yield profusely. With judicious sowing and planting a decent crop can be raised throughout the year. For the proper discharge of pollen and the setting of the maximum number of fruits, a dry atmosphere is most favourable. Bees have not at any time been found to visit the flowers and do not appear to help their pollination.

The preparation of the soil and the general principles of cultivation are almost the same as for any other garden crop. In places like Coimbatore and adjoining districts, where the temperature is high it is advisable to give the land a deep ploughing. If the roots of the plants come in contact with the hot soil on the surface the plants die quickly. The soil should be stirred and pulverised well before planting and a perfect tilth obtained.

Manuring. An initial dose of 10 to 15 tons of good well-rotten farm-yard manure ploughed in sufficiently early (at least a month) before the crop comes in, has been found to be quite beneficial. Artificials can be used whenever found necessary. Potash may be applied at the start and nitrogenous manures in smaller doses later on during the early growing stages. The application of too much nitrogen may induce a leafy growth which is detrimental to the yield. About 2 to 3 cwts. of potash and 1 cwt. of nitrogenous fertiliser can be applied with great advantage. The application of fresh manure seems to delay the ripening of fruits whereas the artificials hasten it.

Planting. Line planting is advantageous and in irrigated soils the field should be divided into ridges and furrows. Each furrow may be formed 3 to 4 feet apart. The seed may either be sown along one side of the ridge and water let in, or a nursery may be raised and the seedlings transplanted when they are 25 to 30 days old. The latter method is however more satisfactory as there is a considerable reduction in seed rate. The seedlings can be planted 1½ to 2 feet apart in the row. Three to four ounces of seed are quite ample to raise a nursery to plant an acre. Tomato can also be propagated by cuttings. There

is no advantage, however, in so doing as the plants raised from seed are more prolific than those raised from cuttings.

Propping. The plants as they grow have a tendency to spread on the ground and require artificial support to make them grow erect. This can be done by driving in stakes 5 to 6 feet long, vertically into the ground and tying the plants on to them. Stakes can also be planted 6 feet apart in rows and horizontal scantlings tied on to these. The plants can then be easily trained on to them. It no doubt is costly. If the plants are allowed to grow on the ground without support they will grow well but intercultivation will not be possible and harvest will be difficult. The fruits that come in contact with the soil and moisture are liable to be spoilt. Propping however, does away with these drawbacks and permits of an easy access of air and sun to the fruits and controls diseases. The plants if allowed to spread on the ground strike root at every node and grow vigorously. In consequence, more fruits are produced sometimes thus more than recompensing for the damage due to rotting.

Pruning. Pruning is another operation which is greatly in vogue, The advantages of pruning under Coimbatore conditions, are, however. doubtful and it has to be done with caution if done at all. Pruning consists in pinching off the lateral shoots at an early stage so that they may not interfere with the development of the racemes produced at the leaf axils. The advantages of pruning are early ripening, reduction of disease and production of bigger fruits.

Interculture. Hoeing and weeding should be done as often as required and the area kept neat and clean. Watering is also quite necessary except during the rains and the leaves should not be allowed to fade. Drainage on the other hand is equally important.

Pests and diseases. The plants are subject to various insect and fungus attacks. These have to be dealt with promptly. Spraying with Bordeaux mixture when the plants are about a fortnight old and repeated 2 or 3 times at intervals of about 2 to 3 weeks, has been found beneficial in checking leaf diseases. Besides being a fungicide, Bordeaux mixture serves as a repellant for several insects.

Varieties. There are many varieties of tomatoes in the market, showing great variation in the size, shape and colour of the fruits. There is also great variation in the thickness of the skin, in the flavour and the juiciness of the pulp. The following are some of the varieties that have been successfully grown in the Central Farm :

Golden queen, Crimson cushion, Perfection,
King Humbert, Erliana, Globe, and Large red,
Peach Ponderosa and Stone.

Notes on the varieties :—

Large Red :— Fruits in bunches of 2 to 3, large, and ribbed, of deep scarlet colour.

Perfection is a fine early variety of a fairly good size, quite smooth and thick and of a scarlet colour.

Golden queen is a smooth bright yellow variety of a high yielding capacity.

Stone is again a scarlet variety of a medium size, smooth and meaty with very fine keeping qualities.

Globe is a pink coloured, globe shaped, medium tomato of a good quality.

Ponderosa has a very good flavour, it is meaty, has a tender skin and fewer seeds, large sized fruit weighing up to 2 pound each.

Crimson cushion—fruits of a big size and akin to Ponderosa. Erliana—medium sized fruits, very smooth and solid. It is an early variety bearing in clusters.

King Humbert with shape of a large plum, produced in clusters of 6 to 8, scarlet colour, of a vigorous growth and tough-skinned. It keeps well.

Peach—a small yellow fruited variety, very attractive having a peach like appearance, fruits formed in clusters, less of acidity.

Duration. The crop remains in the field for about five months and yields fruits for about two months. If desired, the crop can be kept longer in the field but experience shows that it is not advantageous to do so. It is better to allow the fruits to ripen on the plant in which case the fruit contains a higher percentage of sugar and less of starch. A ripe fruit also contains a higher percentage of vitamins A and C. For marketing, however, it is advantageous to harvest the fruits when they are just ripening as they keep longer if done so.

Yield. The yield of ripe fruits varies from 15 to 40 thousand pounds per acre depending upon the nature of the soil, the variety, and the season at which it is grown. A mixed crop of tomato varieties planted in an area of about 2 cents during the first week of April 1932 gave a calculated yield of 28,800 lbs. per acre by about the 19th of September 1932. Another crop planted a month later gave an average of 36,000 lbs. of ripe fruits in about the same period. Among this the variety Golden queen gave 43,000 lbs. per acre. The same variety planted on 2—7—1932 gave 43,100 lbs. per acre, even though the average of all the varieties sown at that time was 24,100 lbs. The highest yield so far recorded on the Central Farm was from a 2·6 cent plot which was planted on 8—12—1931, and which yielded fruits from 25—2—1932 to 19—4—'32 It gave 48,000 lbs. per acre. The lowest yield recorded was 10,937 lbs. per acre from a crop sown in July 1931.

Economics. Assuming that the fruit is sold at 6 pies per pound, as it is done on the Central Farm, it is possible to get a gross return from Rs. 400 to Rs. 1250 per acre. The cost of cultivation including

the cost of artificials may not exceed Rs. 160 per acre which means that tomato cultivation is a profitable concern. The following details of cost of cultivation will be interesting:

Details of Cost of Cultivation.

	Rs.	as.	ps.
Preparatory Cultivation:—			
Ploughing once with deep plough and thrice with ordinary plough	7	8	0
Manure and Manuring:—			
15 tons of farm-yard manure at Rs. 4 per ton (Half of which alone is charged for tomato)	30	0	0
Cost of 4 cwts. of artificials	30	0	0
Seed and Sowing:—			
Cost of seed, raising nursery and transplanting	6	8	0
After-Cultivation:			
Interculturing and propping with bamboo stakes (these being used for more than one crop)	20	0	0
Irrigation:—			
Once in 10 to 15 days (In rainy weather only when necessary)	54	0	0
Harvesting:—			
Collecting fruits etc.	12	0	0
Total	160	0	0

Uses. The tomato is used for a variety of culinary purposes. It forms a valuable vegetable adjunct with meat and fish preparations. It finds a place in preserves, sauces and jams. The juice is valued as an invalid food because of its high vitamin contents. In the Indian household it is gaining popularity in various vegetable dishes both cooked and raw.

Conclusion. The demand for tomato in Indian towns and villages has not, however, increased so much as to warrant its production to a large extent. At the rate at which the taste for the fruit is now cultivated, there is certainly a bright future for the crop and it is hoped that a time will come when the crying need will be for more tomatoes. If the cry for eating more fruit and the demand for a cheap yet nutritious fruit, induces the average consumer to grow a few plants in his backyard to supply his own needs, the object of this short note will be more than achieved and it is hoped that the "Love Apple" will then be more endeared in the hearts of one and all.

Acknowledgements. To M. R. Ry. Rao Bahadur C. Tadulinga Mudaliar Avl., Principal, Agricultural College, and M. R. Ry., Rao Sahib T. V. Rajagopalacharyar Avl., retired Vice-Principal, Agricultural College, I am greatly indebted for facilities afforded to start the study of the crop and for valuable suggestions. I am also equally indebted to the present Superintendent, Central Farm, M. R. Ry., R. Swami Rao Avl. Some facts particularly those regarding the vitamins in the fruit were borrowed from Hunter's Encyclopaedia of Scientific Agriculture.

TROPICAL PLANT DISEASES: THEIR IMPORTANCE AND CONTROL.

By Dr. E. J. BUTLER, C. M. G., C. I. E., F. R. S.
Director, Imperial Bureau of Mycology, Kew.

In the great tropical and subtropical plantation industries, such as tea, rubber, coffee, cocoa, citrus fruits, etc., large areas of permanent crops are cultivated on capitalistic lines with uniform and usually white control. On an estate of hundreds or even thousands of acres, often under highly intelligent supervision and where the produce may be worth a great deal of money, it is comparatively easy to get adopted improvements which are the results of scientific research, whether in the control of disease or in any other direction. It is quite a different matter, however, when one comes to deal with the crops grown by the indigenous people of the tropics for their own use. Their agricultural practices are rigidly traditional, their standard of intelligence may be low, money is scarce or even absent, and their crops are raised in small holdings, often subdivided to an almost incredible degree. I once had occasion to acquire 17 acres for expansion of an agricultural research station in India and found 30 families and 91 individual plots represented in this piece of arable land. In such conditions and they are those under which a great part of the population of the world lives—"the cultivator's ways and the sheep's ways tend to be much the same", as an Indian proverb says, and however well the traditional agricultural methods are followed, the cultivator is apt to be helpless in an emergency as, for example, an outbreak of epidemic plant disease.

It is not surprising that the earlier plant pathologists who worked in the tropics, from the time when Marshall Ward went to Ceylon in 1889 to fight coffee leaf disease when it was already too late to save the industry from ruin, should have concerned themselves mainly with the diseases of the great export crops. A study of the reports of fifteen or twenty years ago will show that for practical purposes, India was the only tropical British possession in which it was the policy of the Agricultural departments to devote much of their attention to the crops grown by the people of the country for their own use. During the past ten years, however, there has been a considerable improvement in this respect in the British colonies, especially those of tropical Africa. Most of the colonies have one, and a few have two, plant pathologists attached to the Agricultural departments and whereas in several of them there are no plantation of crops, the needs of the village cultivators are receiving attention. Even in some of the more advanced 'plantation' colonies such as Ceylon and Malaya, the large plantation industries have now organised their own research departments, leaving the Government departments of agriculture free to concentrate on the improvement of the local crops and methods of farming.

Such improvements are likely to increase the responsibilities of the plant pathologists. New and improved varieties of crop plants are liable to become attacked by diseases from which the old ones had become immune through age-long selection, and more intensive methods of farming often have a similar result. The great activity in crop improvement that has been characteristic of agricultural development in the United States and Canada since the beginning of the present century, has been accompanied by such an increased call on the services of plant pathologists that each of the staple crops has, not one but many men engaged in the study of the cause and control of the diseases to which it is liable. As similar efforts are made to improve the staple food crops of the tropics similar needs will be felt. There are clear indications from the work on rice in Japan that even in a crop such as this, which in India is one of the healthiest of all the field crops there are a number of diseases capable of becoming formidable obstacles to the introduction of improved varieties.

The two tropical cereals next in importance as food crops, sorghum and the bulrush millet, are much more subject to disease than rice, but very little work has been done on them in the tropics and even the full life history of several of the common bulrush millet parasites is unknown. Still less is known of the diseases of the tropical pulses and other plants of economic importance except those that are grown for export. Tropical plant pathology has not much to boast of in the study and control of village and field crop diseases; the number of many years of work put into this branch of Agricultural science is too small to have yielded much result and the difficulty of getting the native cultivator to change his ways, as well as his lack of means and general backwardness, has helped to induce a pessimistic outlook amongst those who are charged with the control of agricultural research and amongst the research workers themselves. Nevertheless, not only because there is great preventable loss of crops from disease in the tropics but also because a solid knowledge of the pathology of each crop plant is a necessary concomitant of all attempts at crop improvement, means must be found to surmount these difficulties. Little by little, openings for successful attack on them will appear, and however slow progress may be at first, the next fifty years are bound to see a great improvement in the crops and in the general agriculture of even the most primitive of the African colonies. In this advance plant pathologists will have to bear an ever increasing share.

The work which has been done in India during the past twentyfive years or so illustrates some of the problems that the tropical pathologists have to face in dealing with village and field crops. When the Indian agricultural department was formed thirty years ago extremely little was known of the diseases of tropical plants, though there were a few exceptions, such as sugarcane. The first work done in the mycological branch, therefore, was to make a survey of the diseases of the more important crops, and when many of these were found to be undescribed, a more intensive study of a few was undertaken and lasted a number of years. Two of them, one on palmyra and cocoanut palms and the other on rice, broke out in epidemic form and had to be dealt with on emergency lines, invoking the aid of the administrative services and leading in the palm disease campaign, to legislation of the kind that is familiar in more advanced countries, where it becomes an actionable offence to own a diseased plant without reporting or dealing with it as prescribed. In the campaign against this disease, which was exterminating the palmyra in an area where this was the dominant tree and by far the most useful, nearly a million diseased palms were cut out to save the rest. This and the subsequent legislative action and the discovery that many trees could be saved by removing the bud sheaths in the early stages of attack have been successful in preventing the spread of the disease and in keeping it within manageable proportions. The campaign cost the Government about £ 20,000; but the value of the palms cured by treatment was estimated at about £ 28,000 in 1921, and the number saved from infection must run into millions.

In other cases it soon became evident that the variety of the crop grown was exceptionally liable to disease either because of inherent susceptibility or because disease had been allowed to accumulate in the stock and was being transmitted when diseased material was used for planting each successive crop. In such cases the agriculturists of the department, each of whom had a district under his charge, became invaluable collaborators, both in observing the injury done to particular varieties and in introducing new or more healthy ones.

Then there were the cases where one had to make a direct attack on the parasite and try to kill it or to prevent its spores germinating by the use of fungicides. This at once brought one face to face with the economic limitations of village agriculture in countries like India, where the cultivator usually has

little actual money at his disposal and can only borrow at exorbitant rates of interest.

Copper and sulphur have remained to the present day the chief weapons in the hands of the plant pathologists in their direct attack on fungal parasites. In India they have been used chiefly on the more valuable orchard and garden crops or as seed disinfectants on field crops.

The relative infrequence of destructive epidemics of disease amongst indigenous crops in the tropics as compared with the great plantation crops is not due, I think, as is sometimes assumed, to the circumstance that the latter generally occupy larger continuous areas under the one crop, so that disease germs can multiply and infect more readily. In India there are large areas of village lands mainly under a single crop as rice in 70 per cent of the cultivated land in parts of Bengal or cotton in 60 per cent of Khandesh. Freedom from disease in these cases is probably mainly due to disease resistance having become, through long experience, the determining factor in the selection of the varieties grown, the quality of which is liable to be a secondary consideration and is often decidedly low. In the plantation industries, on the other hand, quality which will enable the produce to compete in the markets of the world is so important that hardiness may be sacrificed. Examples of destructive epidemics in these crops are numerous and are not, as in the other category, usually due to newly introduced parasites. They are just as often due to an old parasite finding in a new variety a congenial host. They are sometimes also due to the considerable financial return leading to expansion of a plantation system into areas not naturally affording optimum conditions for the growth of the plant, so that its environment may become more favourable to the parasite than the host.

The recent wave of epidemic disease that has ravaged the cotton plantations of the Sudan may perhaps find a partial explanation in these considerations. When the great Gezira irrigation scheme, due in its inception to the genius of Garstin and Kitchener, was opened in 1925, it was already established that the highest quality Egyptian long-stapled cotton could be successfully grown in this previously arid waste. At the present time approximately, 200,000 acres of irrigated Sakel cotton is grown as the major crop in the gigantic plantation of 600,000 acres under uniform control and cropping, surely the largest arable farm in existence. During the first five years after the dam was built across the Blue Nile, cotton worth more than £ 12,000,000 was produced from the Gezira, and 150,000 people had settled where before there was only a scattered famine-stricken population.

The cotton disease known as blackarm occurs in all the cotton growing parts of Africa, but it seldom causes much injury to the varieties grown by the people of the tropical regions, and the long stapled kinds grown in Egypt escape damage apparently because the climate of Egypt does not suit the parasite. In the Egyptian varieties grown in the Sudan it became a formidable pest, being one of the main factors in reducing the yield per acre from 479 lb in 1925—26 to 129 lb. in 1930—31. This represents a loss of more than 60,000,000 lb. of cotton on the area grown in the latter year, worth even at the low prices then prevailing, more than £800,000. As the disease is carried mainly on the seed, an elaborate scheme of seed disinfection with the dust known as 'Abavit B' was carried through before the last season's crop was sown, the whole of the seed for this great area, representing more than 30,000 bags, being treated by specially devised seed dusters. Various other steps were also taken to combat the disease, and the yield, when harvest was completed last spring, was found to have risen again to a little more than 400 lb. per acre, or not far short of that of the earlier years.

In this case there is far more at stake than the saving of an industry, however important. The whole future of a province is in the balance. I cannot refrain

from quoting a foreign observer who visited the Sudan two or three years ago. 'The Sudan is the latest thing in European exploitation and it is the best." There has been "created a corps of agriculturists and entomologists to destroy the pests that attack the native crops: a group of veterinarians to look after and to improve the native cattle; and a quite unrivalled body of biologists, bacteriologists, laboratory workers and doctors to fight native diseases. Trekking through the land are the Government biologists and entomologists, experimenting, destroying pests, noting processes, giving advice You rarely find them in the same place for two weeks running; these hardy scientists do even more work in the open than in their laboratories".

The West Indies present a very different picture from the Sudan. There, in some of the oldest of the British colonies, generations of planters and settlers have been engaged in the tropical and subtropical cultivations of lands favoured by Nature to an unusual degree. Jamaica is the largest banana exporter of the British colonies, having sent out 24,000,000 bunches in 1930, representing more than 50% of the total value of her exports In 1912 the first cases of the now notorious Panama disease of bananas in the island were examined by S. F. Ashby. Rigid quarantine measures were promptly introduced by the Director of Agriculture, Mr. H. H. Cousins, impressed by the ruin from this disease which had befallen the banana growing enterprise in the Dutch Colony of Surinam between 1906 and 1910. As soon as a diseased plant was discovered, it and all the surrounding ones on an area of four chains had to be destroyed and the area fenced in. As a result, spread was slow, the number of cases annually not surpassing 100 until 1921. Increase since has been at the rate of about 50 per cent a year, until by 1929, there were about 85,000 cases, involving nearly 140,000 plants in the parish of Portland, the most diseased, some 9000 acres, or approximately one-tenth of the total estimated banana acreage of the island, have now been abandoned. for it has been found that commercial banana growing is impossible on land once infected, and the great United Fruit Company has already abandoned nearly 100,000 acres from this cause in Central America. The expenditure by the Government of some £ 60,000 in Portland no doubt prolonged the life of the plantations by ten years or more, but in the end has proved unavailing.

As there is no direct method of fighting this disease which is due to a soil fungus, attempts to procure resistant varieties are being energetically carried out both in Jamaica and at the Imperial College of Tropical Agriculture in Trinidad. Varietal tests have shown that the Cavendish species of banana and some others are either highly resistant or totally immune. Botanists both from Kew and the West Indies have toured the world in search of varieties for trial and hybridisation and these are grown under quarantine and inspection at Kew before being sent on to Trinidad. Very large numbers of crosses have been made in Trinidad and Jamica and some of the immune seedlings produced in the latter island have given bunches which were acceptable to the trade during the past year. The Trinidad seedling I.C.1. (Imperial College No. 1). a cross between the commercial Gros Michel and a wild species has also shown remarkable immunity during six years tests, but the fruit still requires improvement.

It is estimated that within the next five to seven years at the present rate of increase of the disease and the amount of suitable banana land left, the Jamican export will begin to decline, and the decline is likely to be rapid unless a satisfactory resistant variety can replace the Gros Michel. The breeding work is difficult and slow. It is not easy for the stricken farmers to be patient. The whole population in the coastal parts of the parish of Portland has been brought up to the cultivation of the banana before anything else, and though an alternative crop of marketable value is desperately needed, it will take a long time to

break down prejudices in a one crop population. Many of the people have migrated, but many have remained to make a living as best they can. It is cold comfort to tell them, as there have not been wanting even scientific men to say, that these coastal lands, extraordinarily fertile though they be, are unsuited to the banana because the damp soil favours attack by Panama disease. The local Department of Agriculture has never taken that view but has striven hard to fight the disease, and the extra lease of life that it has given the industry, though insufficient in Portland, may yet save the banana cultivation of the island as a whole.

In the examples selected to illustrate the importance and control of the diseases of tropical plants, there is every gradation in severity from the sorghum smut which levies a moderate toll of about ten per cent of the crop on some millions of acres in India, to the Panama disease which completely exterminates the susceptible bananas and precludes replanting within any reasonable time. The success of the measures which have been adopted to control these diseases also shows every gradation from the complete control which is easy to obtain by disinfection against sorghum smut or by growing Cavendish bananas in Panama diseased land, to mere alleviation which appears to be all one can hope for, but is yet sufficient, against rubber mildew or the root diseases of limes. A consideration of these measures—ruthless eradication, the complete replacement of susceptible varieties, hybridisation or selection to obtain resistant plants, budding or grafting on resistant stocks, modifications in agricultural practices like stubble burning or pre-watering, and finally, the direct attack on the parasite by steeping, spraying, or dusting—indicates how varied is the task of the plant pathologist and how wide must be the foundations of his knowledge if he is to perform it successfully. The old conception of the Mycologist, student of the fungi that cause disease as adequately equipped to fulfil the duties of a plant pathologist, dies hard but it is dying. Like bacteriology in the realm of medicine, pure mycology is a necessary foundation and the mycologist a necessary collaborator, but he is not equipped either as a general practitioner or a specialist in particular diseases.

The practical man is often slow to admit that a destructive disease in a plant is due to agencies outside his control. Confronted with such he is inclined to seek for explanations other than the true one. He looks first for some disorder brought about by cultivation or inbreeding, or meteorological phenomena. Or he thinks that the soil is unsuitable or has become exhausted, or that the plant, if an exotic, has failed to become acclimatised. It is often not until all these have been tested and found wanting, that the true cause is fully realised. Experience has shown that it is unfortunately rare to find the explanation of serious disease in these directions and the dominating factor is usually the presence of a parasite, however much its activities may be favoured by secondary causes.

Failure to recognise the very varied weapons used by modern plant pathology and undue weight given to the secondary factors in the causation of disease have led, no doubt, to the suggestion which I have heard that the "mycologist", as he is still called in most of the British colonies, may be in danger of losing his position as one of the most essential members of any team of tropical research agriculturists. In actual fact there can be no question that, looked on as a member of a team and relying on the collaboration that must exist between him and the plant breeders and agriculturists the plant pathologist is more needed now than ever. Improvement in the crops of the people and the quest of quality or the satisfaction of market fancies in the plantation crops can be relied on to be followed by increase in disease. Unless plant pathologists well-versed in the pathology of the crop concerned are available—and they cannot be produced at a moment's notice—the examples I have given will be paralleled in every Colony in the British Empire.—(*Nature*, 24—12—'32.)

THE LATE DR. C. A. BARBER

In the death of Dr. C. A. Barber which took place recently, the world of Science and especially that group of pioneers in agricultural and plant breeding work in India, has lost a very valuable and distinguished member.

Charles Alfred Barber was born on the 10th November, 1860 at Wynberg in South Africa. When eleven years old, he was sent to England and had his early education in a grammar school at Bath, for six years. In 1878 he entered as a clerk in a District Bank in Newcastle-under-Lyme, and passed through his five years' apprenticeship. Meanwhile he carried on his studies in science privately and passed the London University B. Sc., with honours. In 1883 he proceeded to Germany with the idea of devoting his time entirely to science and was in the famous University of Bonn for a year, and during this period he specialised in Botany and had the privilege of being a student of Professor Strasburger and other famous botanists of that University. In 1884, Barber returned to Christ's College, Cambridge, and as a student secured the place of a demonstrator in Elementary Botany. Gradually he was able to secure a teacher's place and carried on his University studies as well. In 1889 he took the Cambridge Natural Science tripos Part II, in the first class and became demonstrator in Botany at the Cambridge University. In 1891 he was appointed as Superintendent of Agriculture, Leeward Islands, West Indies. After his work there for four years which gave him some experiences of the tropics, he returned to England and became instructor in Botany at the Royal Institute of Engineers at Coopers Hill.

It was in 1898 that Barber left Coopers Hill and landed in India to take up the appointment of Government Botanist, Madras, and with it the Directorship of the Botanical survey of South India. In this dual capacity he had facilities to tour about the province and make extensive botanical collections and get a close acquaintance with the flora and agricultural conditions of South India. His botanical work gradually brought him in touch with economic problems connected with agriculture and his activities had to be diverted to the study of crops in their various aspects. As one who was responsible for starting the experimental Farms at Samalkota, Palur and Taliparamba for the study of special crops, he laid the foundations for the newly organised Madras Agricultural Department. Very useful work continued to be done at Samalkota, Palur, and Taliparamba in the study of sugarcane, groundnut and pepper and all the present output of work on these crops has been built on the systematic foundations laid by him.

For his research work on various items and especially for that on the *haustoria* of the sandal he was awarded the Doctor's degree in

THE LATE Dr. C. A. BARBER, M.A., D.Sc., C.I.E.

Science by the Cambridge University in 1907. In 1908 Dr. Barber joined the new Agricultural College at Coimbatore as the Government Economic Botanist and Professor of Botany and until the appointment of a Mycologist and an Entomologist, he also supervised the work of the Indian assistants in these Departments. In 1912, Dr. Barber was appointed Sugarcane Expert for India and continued in this appointment until he retired in 1919. The work of Dr. Barber as Sugarcane expert and breeder at his sugarcane farm in Coimbatore has gained international fame and we need no more endorsing testimony to his valuable work than the numerous varieties of canes that he has handed over to the Indian cultivator and which are grown everywhere. As a recognition of the valuable scientific work he did, the Government honoured him with a C. I. E. in June 1918. It is needless to state that he has published numerous papers in botany, agriculture and sugarcane work and it is difficult to enumerate them in this brief sketch. And it was only very recently that Dr. Barber gained for his work in sugarcane the Maynard—Gangaram prize of a substantial amount. As a scientific worker Dr. Barber had few equals; his accuracy, clarity, and systematic arrangement of work were features which were inimitable and unique. Those among the officers of the agricultural department who have had the privilege of working with him can never forget the splendid training in both scientific and administrative work which they received from him. In fact, several officers holding responsible places in the agricultural department at present, owe their early training in scientific work to the valuable organising and training capacities of Dr. Barber, and we are sure they cannot forget it; they are all "sparks from my anvil" as Dr. Barber himself used to say. We cannot refrain from stating that Dr. Barber was a man possessed of very high scientific attainments and organising capacities and it is very rare to meet with one of such remarkable qualifications.

In his private capacity, Dr. Barber was a very perfect gentleman with very pleasant and suave manners. He was a good sportsman, and right up to his retirement and even in his retired life he was maintaining his status as a first class tennis player.

In conclusion, we may add that the Madras Agricultural Department was very fortunate in getting the valuable services of such a person as Dr. Barber, for carrying out the pioneering work in placing this department on a secure and scientific foundation; and as long as the department and the College continue, the name of the late Dr. Barber can never be forgotten. Nor is it necessary to state that early steps will surely be taken by his admirers to perpetuate his memory in a very suitable manner.

(Editor).

Notes and Comments.

1. The Poona Agricultural College: In the recently issued report of the Bombay Government Re-organisation Committee, one among the many retrenchment proposals of the Thomas Committee is the abolition of the Agricultural College at Poona. To us, such a proposal comes as a terrible surprise; for, at a time when the general cry all over the country is to divert our activities to agriculture, and 'go back to the land', such a suggestion is not only unexpected, but very unwise. To abolish an institution of the kind which is giving instruction in the most important occupation and industry of the country, is a retrograde step of a very high degree. The College of Agriculture at Poona, is one of the premier scientific institutions in India which has been, and is training up young men for various agricultural careers, and it will be a great pity if the Government of Bombay accepts the views of the Retrenchment Committee, and closes this very useful and popular institution. It is also an irony of fate, that this curious suggestion to close the college should emanate at a time when the Silver Jubilee of the Institution has just been celebrated! We must record our emphatic protest against such a policy which is in the very face of it, a case of false economy.

2. The late Dr. Barber: We very much regret to announce the death last month, of Dr. C. A. Barber for many years connected with the Madras Agricultural Department. Readers might remember that in our January issue we made a reference to a letter received from Mrs. Barber regarding the unfortunate condition of her husband, but we were not prepared for this sad news following so closely. We offer our sincerest condolences to Mrs. Barber and her two children on this sad bereavement, and hope that it will help them bear the sorrow, to know that they have the deepest sympathies of many friends and well-wishers in India, who have known them, and who have worked with the late Dr. Barber in the Madras Agricultural Department. As a humble tribute to perpetuate his memory we are adding a short biography of Dr. Barber which would be instructive and inspiring to many of our young readers.

3. Fruit Culture in Mysore: The Mysore State appears to have started on some substantial lines of research in fruit growing and horticulture, as may be seen from the Government review on the recent administration report of the State gardens in Mysore. The State Government is anxious that special efforts should be taken to develop fruit industry on promising lines; with this idea, they have called for a Research Scheme on fruit culture from the Superintendent of Gardens in consultation with the Director of Agriculture. It is well known, that Mysore has been more or less the pioneer in starting pomological work, and has been importing and growing stocks of

various tropical fruit trees, especially, in and around Bangalore. The State nurseries have, it appears, imported from Australia over five-thousand fruit plants, consisting chiefly of apples, oranges, and grapes. As hinted in our last month's note, this is a good sign of the times when people have begun to appreciate the value of fruits in human dietary, and the consequent desire to grow more and better fruits.

4. World's Grain Exhibition: A world's grain exhibition and conference is to be held at Regina in the Dominion of Canada, during July–August 1933; the prize money offered for the best exhibits of grains amounts to £25,000. The Ministry of Agriculture and Fisheries in England is arranging to inspect and certify the samples from England and Wales, before they are despatched to Regina. Besides England and Wales, other European countries like Italy, Portugal, France and Belgium are also participating in the exhibition competitions. In addition to the exhibition, there is to be a conference of experts from every grain-producing country in the world, with the object of pooling knowledge on every phase of production and marketing. The British Government are expecting to send a delegation. We understand that in this country, arrangements have been made by the Imperial Council of Agricultural Research, to send the best samples of grain produced in the country. Samples of rices, cholam, (*sorghum*) ragi (*Elusine coracana*) are being got ready even in Coimbatore, for despatch to the exhibition. We do hope that the Imperial Council of Agricultural Research may find it possible to send some delegates from India to take part in the conference.

5 The Plight of Tanjore Rice Merchants. Due to various difficulties—especially the competition of Burmah and Circars rice in Ceylon and in the West Coast, combined with the very unfavourable steamer and railway freights—rice merchants in Tanjore are now finding it very hard to secure a favourable market for their delta products, in the West Coast markets as before; and many of the mirasdars in the Tanjore delta are in a very unfortunate plight. To make proper enquiries into this matter, and to suggest means for removing the existing difficulties and providing better marketing facilities, the Madras Government has deputed the Joint Registrar of Co-operative Societies to proceed to Tanjore, and make personal investigations; on his arrival, a meeting was arranged of the leading mirasdars and the Collector, and the special officer discussed the matter at some length. Some of the suggestions offered to the special officer were:— (1) reduction of railway freights by S. I. Ry, (2) the reopening of old ports like Tranquebar and Port Calimere to facilitate transport of rice to Jaffna, (3) the extension of the Vedaranyam railway line to Point Calimere and (4) affording banking facilities and credit system to merchants. It is hoped that the Special Officer may be able to find some possible ways and means and be able to ease the situation.

6. Twenty years' Index for the M. A. J. We invite the attention of our readers to the fact that a complete and exhaustive index of the first twenty volumes of our Journal (1911—1930) has been compiled and is being got printed by the Union. It is hoped that it will facilitate easy reference to all the various papers and other contributions that have appeared in the Journal during the last twenty years. Copies will be ready very soon and at the suggestion of many friends the price has been fixed at a low rate of Re. 1—4—0 per copy and to those who register their applications before April at Re. 1.

7. A New Sugarcane Farm in Chittoor. We gladly welcome the news that the Finance Committee of the Madras Legislative Council have sanctioned the proposal of the Development Department to acquire 30 acres of garden land and 3 acres of dry land in Chittoor, for a sugarcane farm, the experiments therein to be conducted by the Madras Agricultural Department, from out of a grant by the Imperial Council of Agricultural Research. In view of increased import duty on foreign sugar, the expansion of areas under sugarcane locally, has assumed very great importance, and experimental stations for carrying on research on this important crop, as to the best and most economic methods of cultivation, pertaining to conditions of each tract, are an absolute necessity. The experimental station at Anakapalle could but serve the needs of the Circars, and work at this newly proposed farm at Chittoor, will furnish information that could be availed of by cultivators in the central Districts, where the conditions are different from those in the Circars, and where the chief problem is one of lift irrigation and the consequent wasteful irrigation practices. It is true that the central districts grow only a fifth of the total area under sugarcane in the Presidency, but the opening of this farm, will serve to stimulate cultivators owning land under tank irrigation, to increase their area under sugarcane, which compared to other provinces is becoming a neglected crop in our Presidency.

ABSTRACTS

Effect of varying moisture conditions on the growth of rice in typical light, medium and heavy soils of the Central Provinces.—D. V. Bal and R. N. Misra (*Nagpur Agricultural College Magazine, 1933, vol. 7, No. 3, pp. 109–112*). Previous work of the authors had shown (*Agriculture and Live-Stock, India. 1932, vol. 2, pp. 404–416*) that the rice crop showed a better growth in heavy soil not submerged under water than when kept submerged under water in the usual way. The present paper reports the results of pot culture experiments carried out during the years 1929, 1930 and 1931 to test the effect of varying moisture conditions on the growth of rice in three typical soils of the Central Provinces, viz. (a) light rice soil (Matasi soil; silt 40%, clay 18·4% water holding capacity 30%); (b) medium rice soil (Dorsa soil; silt 24%, clay 40%, water holding capacity 43%), and (c) heavy rice soil (Kanhar soil; silt 13%, clay 53%, water holding capacity 54·3%). Quadruplicate pot experiments, under manured and unmanured conditions, carried out during the three years, showed that:— (1). In the case of light

soils, submerging the soil under water, acted beneficially and gave as good yields as when the water was added from time to time when necessary. (2). In the case of medium soils, submerging the soil under water gave lower yields than when water was added by instalments, and the difference was about 10 to 20%. (3) In the case of heavy soils, there was a serious decrease in yield amounting to about 50 to 75%, when the soil was kept submerged under water. If on the other hand, water is added to such soils from time to time to keep them at the maximum water holding capacity, a normal yield equal to that of light soils was obtained. (C. N.)

Silage investigations at Bangalore. IV. Ensilage of Jowar Straw :— T. S. Krishnan (*Agriculture and Live-Stock in India, 1932, vol. 2, part vi, pp. 619–626.* Cf. M. A. J. *Vol. XXI pp. 41.*) Jowar (*Sorghum vulgare*) is raised extensively in many parts of India as a fodder crop. In varieties where the grain is used for human consumption, the stalks left over are used as cattle fodder. As the straw consists of tough stalks and a few dried leaves and is not relished by cattle, the author has examined the effect of silaging the straw, on its palatability and nutritive value. Before ensilage, enough water was added to the straw to bring down the dry matter content to about 25% ; the mass was kept ensiled in a pit 12 ft. long, 6 ft. wide and 8 ft. deep from December to May. At the end of the period, a silage of uniform quality, having a dark-brown colour and a good soft texture and a pleasant slightly acidic smell was obtained, which might be classed as good " acid brown silage ". It was eaten with great relish by cattle. Feeding experiments conducted with the silage so prepared gave very favourable results. Comparison of the chemical composition of the silage with the original straw showed a loss of about 10% on the dry matter, an increase in ether extractives from 1·68% to 2·11%, being mainly due to increase of volatile organic acids, a decrease in the Nitrogen free extract and mineral matter to the extent of about 20% on the original content. There was also an increase of volatile bases and decrease in amino-acids. The changes were in general in the same direction and of the same magnitude as during the ensilage of Jowar in the prime condition (when earheads just harden), except in the case of the proteins, where there was a smaller amount of decomposition with straw silage (12%) than with the prime stage-silage (30%). The author concludes that subjecting Jowar straw to the process of ensilage should prove of considerable help in the better utilisation of this stuff. (C. N.)

An experiment on Mineral Assimilation from two typical fodders.— F. J. Warth. A. Viswanatha Iyer and N. Krishna Iyer (*Indian Jour, Vet. Sci. 1932, Vol. 2, part 4, pp. 325-332*). Recent work in the field of animal nutrition has emphasised the great importance of the mineral constituents of feeding stuffs, and as it is likely that the problem of minerals may be acute in India, especially in areas which have been cultivated for a long time and also in regions where the soil is exposed to excessive leaching, the authors have, by way of preliminary work, made a comparative test of two typical fodders, viz. *Ragi* straw and *Bolarum* hay, from the mineral standpoint. The samples of *Bolarum* hay used in the experiment, contained on the average 0·834% of lime, 0·078% of phosphoric anhydride and 0·459% of nitrogen, while *Ragi* straw contained 1·136% of lime 0·193% of phosphoric anhydride and 0·511% of nitrogen. The fodders were poor in nitrogen and seriously deficient in phosphoric acid as compared with English fodders. In the present experiment a long period feeding test was carried out with the above two fodders, four bullocks being maintained on each, and a small defined amount of concentrate being fed to all animals alike to maintain the nitrogen balance. The feeding test was divided into the three following main periods. 1st period: the fodder without mineral supplement ; 2nd period : fodder with supplement of calcium phosphate ; 3rd period : fodder with supplement of calcium phosphate and green food. The object of adding green food in the last

period, was to test whether increased assimilation of the minerals was brought about by the addition of vitamins in the green food. During each period, numerous determinations of the mineral balance were made. With regard to *Ragi* straw, it was concluded that it was well provided with lime, since appreciable assimilation took place in the first period. The phosphoric acid appeared to be on the border line of sufficiency. The animals on this ration were evidently not suffering from lime shortage, yet in the second period when a mineral supplement of calcium phosphate was added, there was a further very large assimilation of lime, indicating the probable influence of phosphoric acid on lime assimilation. With regard to the hay ration, the experiments showed that this fodder was seriously deficient in phosphoric acid. The interesting fact was noted that even under extreme shortage of phosphoric acid, the faecal losses amounted to 10 gm. a day indicating this to be the limiting factor. In the present experiment, green grass did not show any noticeable increase in assimilation of the mineral constituents. The authors, finally stress the practical significance of their results and the importance of maintaining the necessary phosphorus supply of mature working bullocks, especially in the slack-season when concentrates are not fed. (C. N.)

Distribution of Soil Moisture after Irrigation:— A. R. Shaw (*Hawaii Planters' Record, 1932 Vol. 36, pp. 73–90*). The object of the investigation was to ascertain the nature of moisture distribution in the soil after different intensities of irrigation Furrows with ridges 12 to 16 inches high and rows 5 inches apart from crest to crest, were filled with amounts of water corresponding to 1·34, 2·0, 4·0 etc. acre-inches of water and after 48 hours, trenches were dug across the rows to observe the extent of penetration of the water. The actual values obtained varied with the nature of soil-type and method of irrigation (contour, long line or border method), but the results showed that, in general, after a light irrigation in a normal loam soil, the wetted area extends laterally to some distance on both sides of the furrow and is of moderate depth. With heavier applications of water, the lateral spread of moisture through the soil does not increase appreciably, but the vertical penetration increases nearly in proportion to the quantity of water used and much may be lost if the irrigation is heavy. There was no evidence to show that in a well drained soil there is any appreciable movement of moisture from wet to dry soil by capillary attraction. (C. N.)

A comparative study of Corn and Molasses as Basal feeds for Swine:— D. R. Gochangco. (*The Philippine Agriculturist, 1933 Vol. 21, No. 8, pp. 560—571*). The object of this study was to determine and compare the feeding value of molasses and corn as basal feed (a) for growing pigs, and (b) for gilts for breeding purposes. 21 Berkjala weanlings and 14 gilts were used in the experiments which ran over a period of about 7 months; and the rations consisted of rice bran 60 parts; copra meal 18 parts; and shrimps 2 parts together with either corn 20 parts or molasses 20 parts or a mixture of corn 10 parts plus molasses 10 parts. The results showed:— (1) In the mixture of feeds used in these experiments, for growing pigs and gilts, one part of molasses was equal to one part of corn in feeding value. (2) Molasses should be substituted partly or wholly for corn, especially when the latter becomes scarce or the price high. (3) To prepare an animal for show purposes, molasses appears to be a better feed than corn, as it imparts more readily plumpness, smoothness and refinement in the general appearance of the animal. (C. N.)

Infestation of Stored Products by Insects:— J. W. Munro, (*Nature, Jan. 21, 1933*). Prof. J. W. Munro of the Imperial College of Science and Technology has contributed an article in Nature (Jan. 21,1933) on the above subject. The article summarises the results of study of the scientific problems underlying infestation of stored products by insects and fungi, done at the special laboratory of the

Imperial College started in 1927 with the grant provided for the purpose by the Empire Marketing Board. The work is divided into three sections: survey and intelligence work at the London docks, research and experimental work in the laboratory, and commercial scale experimental work on sterilisation of infested produce and warehouses in London and other ports.

A survey work of the insects associated with cocoa, dried fruits, spices and tobacco stored in London warehouses showed that upwards of 140 species of insect are represented, though only a few of them are of prime importance. The main results of the survey work have shown that in nearly all—if not all—instances, infestation begins in the exporting country and that it is aggravated by storage in Great Britain.

The laboratory research and experimental investigations in progress comprise entomological, mycological and chemical work. In the entomological branch, the problem studied is concerned mainly with the rearing of very large numbers of insects for experimental work, on such lethal agents as heat, cold and fumigant gases, and with various problems relating to the respiration of insects in different stages of development.

In the chemical section of the laboratory, research and experimental work on the relative toxicity of various fumigants to insects and on the partial vapour pressures of fumigant vapours and gases generally used in admixture have been carried out and awaits publication. According to Prof. Munro, it is found that in the fumigation of ships, warehouses, mills and produce as practised commercially, no serious attempts are made to determine the behaviour of gases used during the actual process of fumigation. It appears that the concentrations of fumigants as are recommended or employed in practice are based on experimental work in which the kind and extent of living insect material used are quite inadequate. In the experience of the Professor, five, ten, or in rarer cases, thirty insects which are considered ample for experimental work are far too small and in the commercial work done by the Professor he was not satisfied with the results unless 2 to 4 thousand insects reared or produced under known conditions were subject to such experimentation. A study of the behaviour of gases during fumigation has shown that temperature effects are not allowed at all, the very high absorption of fumigants by the products themselves is altogether underestimated, and quite inadequate measures are taken to ensure proper diffusion and distribution of the gas. The most important direct contribution to the 'control' of insect infestation that has been made by this special laboratory is in directing attention to these defects and providing means of overcoming them.

Efficient fumigation is not, however, the final aim of the work at this laboratory because the ultimate reduction of the losses caused by insect infestation of stored produce depends on the acquisition of a fuller knowledge of the insects concerned than is possessed at present. Subjects on which promising research work is being conducted as time and funds allow are the temperature and humidity conditions—both in the atmosphere and in the product—which are most favourable to various insects, and the relationship of the mould-causing fungi to the insects' food supply. (K. R).

Gleanings.

Synthetic Quinine Substitute. Recent work at the University College of Science, Calcutta, has been carried out in an endeavour to synthesise a compound which might replace quinine, the production costs of which are very heavy. It is now reported that Professor H. K. Sen and Professor W. Basu have obtained a substance in the laboratory which on testing has been found to be a good

substitute for quinine. Whilst having the same antiparasitic value, it has the advantage of not producing the side-effects associated with quinine, and the taste in water is not so bitter The compound is an ammonium salt obtained in work on coal-tar derivatives, and it is stated to be moderately soluble in water. (*Chem. and Industry*, 1932, Vol. 51, P. 884).

Science—Fundamental and applied. What the ordinary citizen so often fails to realise is the part which fundamental scientific research (exemplified by that performed at the universities) and applied technical research (exemplified by that performed by the industries themselves and by such agencies as the Department of Scientific and Industrial Research) is *already* playing in maintaining him with some degree of stability and comfort in that state of life which he has reached. Nor does he properly appreciate the crash—industrial, political, and social—which would necessarily follow the neglect of opportunities to acquire new knowledge of material resources and new power to use them.

It is the business of scientific men and women to explain to others the position as they know it and the future as they see it. To-day it is more necessary than ever before that they should strive to show the voter that research is not merely the concern of the capitalist who uses it to safeguard his possessions ; not only the concern of the employer whom it helps to use services and materials to the best advantage ; not only the servant of the worker, the conditions of whose labour have, in many cases, been improved out of all recognition ; but also the benefactor of the poor, into whose homes it brings much that was formerly reserved for the rich ; and the chief hope of the unemployed, whose chance of a job depends so much on the development of new industries, Where industry and research are concerned, we are indeed all ' in very much the same boat '. The bigger and the better we can make that boat, the happier and the safer we shall be. (Extract from ' *Nature*, No. 3293. Vol. 130, pp. 862-863 '.)

Toothpaste Facts and Fancies. In spite of what the advertisements say, it's the tooth-brush that cleans your teeth ; the tooth paste is of negligible importance, according to S. M. Gorden and E. W. Shard of the American Dental Association Bureau of Chemistry. The merits of the different brands of toothpaste are mostly confined to the imaginations of the men who write the advertisements, say these two chemists, for all toothpastes are mostly calcium carbonate or phosphate, soap and flavouring. Recent work of the Bureau, reported in " Industrial and Engineering Chemistry ' was undertaken to check up on the claims of one tooth paste advertiser to the effect that his product has a low surface tension—the inference being that thorough brushing of the teeth is unnecessary. Just work up a lather in the mouth and the penetrating foam with its low surface tension will penetrate into the crevices between the teeth and remove every particle of debris lodged there. The investigators found that there is not enough difference in the surface tension of various toothpastes to distinguish one from another, and they intimate that even if there were, it would not mean any thing as far as the actual cleaning of teeth is concerned. (*Scientific American*, January 1933).

Absolute Alcohol. Removing water from alcohol to produce " Absolute alcohol " has been a tedious process and many attempts have been made to dehydrate alcohol more cheaply and easily. In Germany, this has been achieved by the use of an azeotropic distillation process in which benzol or gasoline is added to form a ternary system with alcohol and water. In the upper part of the rectifying column, a ternary mixture of alcohol, benzol and water, boiling lower than alcohol is distilled off, whereas in the column itself, absolute alcohol remains. The ternary mixture is then allowed to settle into two layers, which in turn are used in the process again. This process which has already found considerable use, has been improved by the use of trichlor ethylene instead of the benzol or

gasoline. The German state monopoly is using the process in six of its plants and obtaining a daily yield of 340,000 litres of absolute alcohol. (*Scientific American*, January 1933.)

Root Nodules and Nitrogen Fixation. As No. 5 in the University of Wisconsin Studies in Science has appeared a sumptuous volume upon the "Root Nodule Bacteria and Leguminous Plants", by E. B. Fred, I. L. Baldwin and Elizabeth McCoy. This monograph reviews critically and adequately the enormous literature dealing with this subject and contains also a very judicial summary of the attempts made upon a commercial scale to supply the causal organism of the nodules to farmers. It is interesting to read the conclusion that nitrogen fixation in pure cultures of the nodule organism outside the plant remains still unsatisfactorily established, though the gain in nitrogen from the air by the activity of the living contents of the nodule is beyond doubt. The authors point out that different types of nodule, with different distribution on the root system, may have different values. They conclude that the best results are obtained when the nodules are relatively few in number and large in size and borne on the tap root and the main laterals. A commonly accepted theory that comes out badly from this critical study is the view that the nodule is to be regarded as an abortive branch root. At the same time, the authors give little indication of the manner in which the vascular tissue develops within the nodule. They review briefly work upon root nodules on plants outside the *Leguminoseae* and also upon the few cases where bacteria are reported as regularly associated as symbionts with leaves. In this review the root nodules of *Casuarina* receive very brief notice but Aldrich-Blake now publishes a note (Oxford Forestry Memoirs, No. 14, 1932) which would add *Casuarina equisetifolia* to the list of plants in which growth is materially improved when nodules are produced on the roots as the result of infection by a mixture of crushed nodules and soil. (*Nature*, No. 3299, Vol. 131, Jan. 21, 1933).

World's Best Yielder: Lady Pride Pontiac Lienwkje, a registered Holstein cow owned by F. E. Murphy, publisher of *The Minneapolis Tribune*, has broken the world's record for combined milk and butter in a 365 day test just completed. This cow produced 35,626 lbs. of milk and 1483 lbs. of butter in the year test. The dam of Lady Pride, while not a world's champion, ranked as one of the highest two year olds of her time with a record of 860 lbs. of butter and 20,825 lbs. of milk, and was a grand-daughter of K. P. Lilith Clothilde, a former world's champion with 1043 lbs. of butter and 22,229 lbs. of milk as a four-year old (Minneapolis Tribune, July 1932, quoted in the *Philippine Agriculturist*, January 1933).

Effect of an Iodine fertiliser on Iodine content of food plant. Owing to the possible therapeutic value of iodine containing foods, some interest attaches to the preliminary experiment on the effect of an iodide applied to the soil on the iodine content of turnips. White egg turnips were grown under uniform conditions, except that one half the plots reeeived potassium iodide at the rate of two kilograms per hectare, while the other plots received a chemically equivalent amount of potassium chloride The potassium salts were applied in the row. The yield of roots and tops was slightly, but not significantly higher with the chloride than with the iodide. However, the small amount of iodide added produced significant differences in the iodine content of the turnips. The iodide treated plants contained 441 and 950 parts per billion of iodine in the roots and tops, respectively, against 165 and 441 parts in the chloride-treated plots. Whether these quantities of iodine in food have therapeutic value is not known to the writers, but the experiment indicates the possibility of large relative increases in iodine content of root crops by the application of iodides. (*Science*, Vol. 76 No. 1981, Dec. 16, 1932.)

A new use for Cellophane. It is sometimes convenient to make records of a permanent nature which can be reproduced on a screen by an arc lamp projection lantern. This can be accomplished in a very simple way at very low cost. Briefly, it is a method of typing on cellophane.

Cellophane is placed upon the carbon side of a sheet of carbon paper, which is placed in a typewriter with a backsheet to protect the rubber roll. Next the typewriter ribbon is adjusted the same as in the making of stencils. The letters which are produced in this way are dark and sharply defined. If a permanent record is to be made, the cellophane is placed between two pieces of glass cut to the size of projection lantern plates. If some discarded lantern plates are available, place them in water for a short time and then the emulsion can be scraped off. The pieces of glass are then sealed around the edges with mending tape. If the record is not of a permanent nature, the cellophane can be used between the plates without the necessity of the plates being sealed.

In making a graph the procedure is the same, with the exception that the graph is drawn on the cellophane with a pencil. The pencil will not mark, but a clear record is obtained from the carbon paper.

Care should be exercised in handling the cellophane, as the completed work can be rubbed off with the hands.

This method has proven satisfactory in the reproduction of the words of songs for chapel exercises and in the making of blueprints and in the drawing of graphs and diagrams to be used during an illustrated lecture when it is impossible to have the use of a blackboard or when a blackboard is not available. These are a few of the uses to which this work is adapted. (*Science*, Vol. 76, No. 1981, Dec. 16, 1932)

Crop and Trade Reports.

MADRAS PRESIDENCY

Cotton, raw in the Madras Presidency, 1932. The receipts of loose cotton at presses and spinning mills in the Madras Presidency from 1st February 1932 to 31st January 1933 amounted to 437,376 bales of 400 lbs. lint as against an estimate of 423,610 bales of the total crop of 1931–32. The receipts in the corresponding period of the previous year were 333,546 bales. 325,153 bales mainly of pressed cotton were received at spinning mills and 118,046 bales were exported by sea while 38,346 bales were imported by sea mainly from Karachi and Bombay. (*From the Director of Agriculture, Madras*).

Cotton Crop Madras, 1932–33—Fourth Report. [On an average of the five years ending 1930–31, the area under cotton in the Madras Presidency has represented 8·9 per cent. of the total area under cotton in India.] The figures in this report relate to the cotton crop sown between April 1932 and January 1933 (Estimates up to the 25th January 1933.) (1). The area sown with cotton is estimated at 1,956,100 acres as against 2,175,700 acres for the corresponding period of last year. There has been a decrease of about 10 per cent. (2). Two hundred and twenty-eight thousand five hundred acres have been reported as sown since the last December forecast was issued. This extent is made up of 87,200 acres of Tinnevellies, 52,000 acres of Cambodia, 42,000 acres of Northerns and Westerns, 30,200 acres of Salems and 17,100 acres of Cocanadas. The area sown in December and January is less than that sown in the corresponding period of the previous year by 169,700 acres or about 43 per cent. (3). The decrease in area occurs in all districts outside Vizagapatam, Nellore, South Arcot, Salem and Trichinopoly. The decrease is marked in the Deccan (—212,100 acres). It is due partly to unfavourable seasonal conditions and partly to the preference for groundnut.

The area under irrigated cotton, mainly Cambodia, is estimated at 190,700 acres as against 161,900 acres for the corresponding period of last year, an increase of about 18 per cent. (4) Picking of the mungari or early sown crop in the Deccan is over. The yield was below normal due to drought in the growing period. The crop is coming into the market. Normal yields are expected in all districts outside the Deccan and Nellore. The hingari or late sown cotton has been affected by drought and the crop is expected to yield only 85 per cent. in Bellary and Anantapur. (5). The seasonal factor for the Presidency works out to 95 per cent. of the average as against 92 per cent for the corresponding period of last year. On this basis, the yield works out to 420,000 bales of 400 lb. lint against 430,300 bales for the corresponding period of last year. It is, however, too early to estimate the yield with accuracy as the harvest has not yet commenced in the major portion of the area and much will depend upon the future weather conditions and toll taken by insect pests. (6) The wholesale price of cotton lint per bale of 400 lb. as reported from important markets towards the close of January was Rs. 80 for Cocanadas and red northerns, Rs. 88 for white northerns, Rs. 87 for westerns (mungari crop) Rs. 108 for Cambodia, Rs. 100 for karunganni cotton, Rs. 87 for nadam cotton and Rs. 97 for Tinnevellies cotton. (*From the Board of Revenue, Madras.*)

Madras Paddy Crop Final Report 1932—1933. (On an average of the five years ending 1930—31, the area under paddy in the Madras Presidency has represented 13·3 per cent of the total area under paddy in India. The figures in this report relate to the paddy crop sown between February 1932 and January 1933.) (Estimates up to the 25th January 1933.) The area sown with paddy in 1932—33 is estimated at 11,582,000 acres as against 11,609,000 acres for the corresponding period of last year and the finally recorded area of 11,537,03 acres in 1931—32. The present estimate exceeds the final area by about 0·4 per cent and the area in an average year by about 3·7 per cent. 2. One million two hundred and seventy thousand acres have been reported as sown since the last December forecast was issued. The extent sown was large in East Godavari, West Godavari, the Carnatic (345,000 acres), Chittoor, North Arcot (160,000 acres), Trichinopoly and the South (307,000 acres). The area sown in December and January is greater than that sown in the corresponding period of the previous year by 21,000 acres or about 1·7 per cent. The area under second crop paddy is expected to be normal generally. 3. The harvest of the main crop outside the Circars is in progress. Normal yields are expected in all districts outside Vizagapatam, East Godavari, West Godavari, Kurnool, Chittoor, North Arcot, Trichinopoly, Tanjore and Tinnevelly. The crop is expected to yield only 85 per cent of the normal in West Godavari owing to the attack of insects and fungoid pests. The seasonal factor for the Presidency works out to 97 per cent of the average as against 99 per cent in the season and crop report of last year. On this basis, the yield works out at 104,748,000 cwt. of cleaned rice as against 107,702,000 cwt. estimated in the season and crop report of last year. The yield in an average year is estimated at 105,170,000 cwt. 4. The wholesale price of paddy per imperial maund of 82 & 27/ lb. as reported from important markets towards the close of January ranged from Rs. 1—4—0 to Rs. 1—6—0 in Tanjore, Trichinopoly and South Arcot, and Rs. 1—12—0 to Rs. 2—4—0 in the other districts. (*From the Board of Revenue, Madras.*)

ALL INDIA FORECASTS:

Rice crop of 1932-33. The total area reported is 82,026,000 acres, as compared with 84,260,000 acres in the previous year; The total yield is estimated at 30,655,000 tons of cleaned rice, as against 32,988,000 tons in 1931-32. The decrease is 3% in area and 7% in yield. The condition of the crop is, on the whole reported to be fairly good. But the crop was very much affected in Bihar and Orissa and in the United Provinces by insufficient rains. The average yield per acre works

out at 837 lbs. as against 877 lbs. in 1931–32, 871 lbs. in 1930–31 and 865 lbs. both in 1929–30 and 1928–29. The average percentage of the area under rice in the different provinces on the total all-India area under rice for the five years ending 1930–31, and also the provincial acre yields are given below—Bengal 24% and 961 lbs. per acre; Bihar and Orissa—16·7% and 912 lbs. per acre; Burma 15·1% and 749 lbs. per acre; Madras 13·3% and 1045 lbs. per acre; United Provinces 8·7% and 676 lbs. per acre; Central Provinces and Berar 7·3% and 710 lbs. per acre; Assam 5·4% and 774 lbs. per acre; Bombay 4·2% and 1026 lbs. per acre. The total quantity of rice (both in the husk and not in the husk) exported from British India to foreign countries by sea during 1932, was 2,142,900 tons of which Burma contributed 1,883,700 tons, Bengal, Bihar and Orissa 152,400 tons and Madras, Bombay and Sind 106,800 tons. The principal foreign countries to which exports were directed were the United Kingdom (138,800 tons), Germany (176,400 tons), Ceylon (396,100 tons), China (443,900 tons) and Netherlands (75,500 tons). The coastwise exports from Burma to Indian ports were 940,500 tons. Advices from foreign rice growing countries show increase of area and yield in Formosa, Siam, Japan, and Java, and decrease of yield in the United States, Italy, Korea and Cochin China. (*Abstracted from the Indian Trade Journal, Feb. 23, 1933.*)

Groundnut crop of 1932–33. The total area returned is 6,952,000 acres, as compared with 5,489,000 acres in 1931–32 or an increase of 27 per cent. The total yield is estimated at 2,836,000 tons of nuts in shell, as against 2,276,000 tons last year, or an increase of 25 per cent. The condition of the crop, on the whole is reported to be fairly good. The contributions of the different provinces for the All-India, crop are as follows:— Madras, area 3,494,000 acres, 53·7 per cent. of total area, yield 1,631,000 tons, yield per acre 1,046 lbs. Bombay (including the Indian states), area 1,666,000 acres, 20·4 per cent. of total area, yield 684,000 tons, acre-yield 997 lbs. Hyderabad, area 1,118,000 acres, 8·7 per cent of total area, yield 320,000 tons, acre-yield 641 lbs. Burma, area 492,000 acres, 9·1 per cent. of total area, yield 157,000 tons, acre-yield 715 lbs. Central Provinces and Berar, area 182,000 acres, yield 44,000 tons, acre-yield 542 lbs. The total quantities exported by sea to foreign countries during the nine months April to December 1932, were 275, 700 tons; as compared with 475,200 tons in the corresponding period of 1932; the principal exporting provinces were Madras (215,500 tons) and Bombay (60,100 tons) and the importing countries were France 112,600 tons, Germany 20,500 tons and Netherlands 32,300 tons. (Abstracted from *the Indian Trade Journal, Feb. 23, 1933*).

Castorseed crop of 1932–33. The total area reported is 1,581,000 acres, as compared with 1,583,000 acres last year. The yield is estimated at 146,000 tons as against 145,000 tons last year. The condition of the crop on the whole, is reported to be good. The position of the different provinces is as follows:— Hyderabad, area 838,000 acres, 44·4 per cent. of total area, yield 61,000 tons, acre-yield 163 lbs; Madras, 334,000 acres, 23·1 per cent. of total area, yield 35,000 tons, acre-yield 235 lbs; Bombay, area 116,000 acres, 8·5 per cent. of total area, yield 19,000 tons, acre-yield 367 lbs; Mysore, 111,000 acres, 8 per cent. of total area, yield 6,000 tons, acre-yield 121 lbs; Baroda 78,000 acres, 7·8 per cent. of total area, yield 7000 tons, acre-yield 201 lbs; Bihar and Orissa, 52,000 acres, 3·6 per cent. of total area, yield 8000 tons, acre-yield 345 lbs; Central Provinces and Berar, 38,000 acres, 3·4 per cent. of total area, yield 7000 tons, acre-yield 413 lbs. The quantities exported by sea to foreign countries during the nine months April to December 1932, were 68,200 tons, as against 91,300 tons during the corresponding period of the previous year. The chief exporting provinces were Bombay (42,700 tons), Madras (22,300 tons), and the importing countries were, the United States (23,200 tons) the United kingdom (16,900 tons) and France (11,900 tons). (Abstracted from *the Indian Trade Journal, Feb. 23, 1933.*)

ASSOCIATION OF ECONOMIC BIOLOGISTS.*

Under the auspices of the association Mr. D. G. Munro, Deputy Director of Agriculture, VIII Circle gave a lecture on "The Potatoes in Nilgris". Mr. G. N. Rangasami Ayyangar, President of the association, occupied the chair.

To begin with, the lecturer gave a brief outline of the history of potato cultivation, how it was first introduced into England in 1587, the several visicitudes it had undergone, and the origin of most of the varieties cultivated at present. The crop was first introduced into India in the 17th century and tried in a great many of the hill stations in North India and also in Nilgris. So far as Madras was concerned the bulk of the potato area was confined to the Nilgris which from 730 acres in 1875 had now increased to over 11 thousand acres. Mention had been made in some of the early records of seedlings having been raised, but none of them appeared to have stood the test. Even in Punjab where some seedlings had been raised locally, none of them was found to compare favourably with the imported ones. The main work on potatoes was now centred in the importation of varieties and selection of the best of them for local cultivation.

He then mentioned about the phenomenal increase in the area in Nilgris during the war time due to a demand for export and the favourable increase in prices. In addition to the increase in the area, which had nearly doubled during the war time, the use of artificial fertilisers had also contributed to the increased output so that, the produce from the Nilgris was at present four times the quantity produced before the war.

The total area under potato in Nilgris, the lecturer stated might be divided into

1.	Irrigated crop	Jany.	May	200 acres
2.	Main crop	Apr	Sep.	6,600 ,,
3.	Second crop	Sep.	Dec.	33,000 ,,

The uneven distribution of the area among the three crops was stated to have introduced difficulties with regard to seed supply. The irrigated crop which has to supply seed for the second crop is too small to supply the required quantity of seed that the ryots are obliged to lift the main crop early, keep the produce for a month and then plant it for the second crop. Even then the planting sometimes gets delayed and the crop gets caught in the December frosts.

The experience at the Nanjanad research station has been that it was not possible to rotate potato with any cereals due to the high acid nature of the soils. This is, however, being counteracted by the application of large doses organic matter and lime, and this is expected to ulimately reduce the present high cost of cultivation He then dealt in detail the estimation of the produce prevalent in the tract as so many times the quantity of setts used. This estimation was very unsatisfactory as it depended on the size of the setts planted. Ryots usually plant about 8 bags (1 bag is 80 lb.) of setts to the acre, the size of the setts being 1 oz. and less. If however the setts were bigger, more would have to be planted so that there could be no relation between the quantity of setts planted and the quantity of produce obtained. Certain experiments conducted at the Research Station has thrown light on the point, as will be seen below:

Size of sett planted	Yield of produce in relation to seed used.	yield per acre, mds.
1 oz.	9·9 times	325 ,,
2 ,,	5·1 ,,	395 ,,
2 ,,	5·2 ,,	430 ,,
3 ,,	4·0 ,,	517 ,,

* Report of a meeting held on 17th February 1933.

So according to the ryot's method of computing the yield, the yield obtained by planting 1 or 2 oz, setts was greater than from planting 3 oz. setts although, it is the planting of the latter that has given the heaviest yields. The planting of bigger setts also showed another advantage in that they could be planted wider apart. The practice adopted at Nanjanad was to have the rows 2 to 3 feet apart with the seeds planted 9 to 12 inches apart in the row.

The lecturer then briefly described the different varieties of potatoes grown in the Nilgris, the two most important of them being Kidney and Great Scot. These two varieties have the advantage of sprouting early. Besides work on varieties there have been experiments going on with regard to suitable methods of cultivation and manuring. It has also been found possible to keep down the incidence of disease by adopting systematic rotation. The manurial experiments have clearly pointed out that a mixture of farmyard manure and artificials give better results than either of them applied alone. A mixture of groundnut cake, sulphate of ammonia, and steamed bone-meal in definite proportions is now being applied on a basal dressing of dung and this has greatly increased the yields obtained. The average yields which were 2·48 fold before, have now gone up to 5·85 fold since the introduction of systematic manuring, better cultivation and better rotations. The ryots, however, are still relying chiefly on artificials which they apply sometimes at the rate of 3 to 4 tons to the acre. Very little trouble is taken to collect the available farm yard manure and use it for the potato crop. It has been demonstrated at Nanjanad that it is possible by practising judicious methods of conserving, nearly 6 tons of manure could be obtained per head of cattle in a year. There are, however, two disadvantages with the farm yard manure namely 1. the diseased and rotten potatoes which are usually thrown in the manure pit might help in the dissemination and spread of the disease when the manure is applied to the soil, and 2. the manure being bulky difficulty is experienced in its transport to the field all by head loads along foot paths.

The Imperial Council of Agricultural Research has now sanctioned funds to undertake research work in potatoes. When the scheme is given effect to, the lecturer hoped to undertake regular breeding work and supply of good seed to the ryots in addition to the cultural and manurial experiments that have been going on.

At the close of the lecture, several of the members and students applied to the lecturer for additional information on various points raised in the lecture to all of which he suitably replied. With a vote of thanks to the lecturer proposed by the president the meeting came to a close late in the evening. (K. R.)

College News and Notes.

Games. Hockey—The Parnell cup. The interclass hockey tournament for the Parnell cup provided more than passing interest. Each class played the other classes twice and the championship was well contested. In their first match, class iii beat class ii by one goal but in their second encounter the game ended in a pointless draw. In their first match against class i, class iii sustained a defeat by one goal, but in their second meet they avenged their defeat and won convincingly by a margin of 3 goals. Thus class iii who secured 5 points against 4 of class i and 3 of class ii, annexed the cup.

Tennis. In the American sealed handicap doubles tournament the entries totalled 36. The results proved to be a very keen contest, the scores made by the winners (Venkata Sastri and Murugesan) being 174 games against 173 of the runners up (Radhakrisna Rao and Joseph) and 172 of the pair (Ananda and Veeriah) which won the third rank.

Cecil Wood Cup. The annual singles tournament for the Cecil Wood cup was won by Moncey Joseph of class i, who beat Ananda of class ii in the finals.

College Colours. The College colours for the year were awarded as follows:— *Cricket.* U. Narasinga Rao, (class i) S. Varadarajan (class iii) and K. M. Narayanan (class iii); *Football.* Bennet Massilamony (class ii); *Tennis.* Moncey Joseph (class i).

Athletics. The annual conference of the Madras Agricultural Students' Union having been postponed, the athletic sports run under the auspices of the Union did not take place this year but the Students' club rightly took up the responsibility of running the sports. The sports were held on Saturday the 11th March and the results of the competition were as follows:—

100 Yards dash. (1) A. M. Kulandai, (2) S. Varadarajan, (3) Mohomed Obeidulla Shah.

High Jump. (1) K. M. Narayanan. (2) S. Varadarajan. (3) N. Muthuswami.

Shot Put. (1) Mohomed Obeidulla Shah, (2) B. Suryanarayanamurthi.

Long Jump. (1) K. M. Narayanan, (2) Mohomed Obeidulla Shah, (3) Sam Joshua.

Quarter Mile. (1) A. M. Kulandai, (2) Sam Joshua, (3) Nagarajan.

Throwing the cricket ball. (1) Sahadevan. (2) K. Lakshmanan.

Javelin throw. (1) Narayana Pillai, (2) Srirama Reddy.

Mile Race. (1) D. Satyanarayana, (2) K. Lakshmanan, (3) Balakrishnan Nair.

Kicking Foot ball (1) N. Muthuswami, (2) B. Suryanarayanamurti.

Sack Medle. (1) A. M. Kulandai, (2) K. M. Narayanan.

Slow Cycle Race. (1) S. Varadarajan, (2) P. Satyanarayana.

Three-legged race. (1) Narayanan and Varadarajan, (2) Kulandai and partner.

Pick-a-back race. (1) Govinda Panikker and partner, (2) Sam Joshua and partner.

Blind man's Buff. (1) Arunachalam, (2) Panikker.

Sack race. (1) Krishna Menon, (2) Panikker.

Wheel Barrow race. (1) Kulandai and partner, (2) Panikker and partner.

Musical chairs. (1) Seshagiri Rao, (2) Kulandai.

The winners of tournaments in the indoor and outdoor games were as follows:— *Chess* (1) Rajan, (2) B. S. Murti; *Ping-pong* (1) Ananthanarayanan, (2) Muthuswami; *Draughts* (1) Doraiswami, (2) K. Krishnamurti; *Badminton Fives* Class ii; *Badminton doubles* (1) Class ii, (2) Class i; *Volley ball* Class ii; *Basket ball* Class iii.

Elocution Contest. The annual elocution competition of the Student's Club was held on the 15th March. Mrs. Jesudass, M.A., L.T., Mrs. Karunakar, B.Sc., Rev. Edmund Bull, Chaplain of Coimbatore, Rao Bahadur T. S. Venkatraman, and Rao Bahadur C. Tadulinga Mudaliar formed a committee of judges, the subject announced being "The position of Indian Agriculture in 1983." The first, second and third places were awarded to Messrs. Y. V. Narayanayya, F. L. Daniel, and D. C. Hanumantha Rao respectively.

The Students' Club Day. The students' club Day was celebrated on the 18th March with great *eclat* when a long and varied programme was gone through. The proceedings began at 4-30 p.m. with a meeting in the Freeman hall under the presidency of Dewan Bahadur Sir T. Vijayaraghavachariar, K. B. E., Vice-chairman of the Imperial Council of Agricultural Research, who distributed the College prizes and medals to the winners. The prize winners for the year were as follows:—

The Robertson medal— R. Suryanarayana.

The Kees prize, The Clogstoun prize, and the Dewan Bahadur R. Raghunatha Rao prize—K. Bushanam.

The Anstead medal—N. Srirama Reddi.
The K. S. Venkatramier medal—S. V. Parthasarathy.
The certificate course cup and the D'Silva prize—M. Bhavani Sankar Rao.
The Goschen prize— B. W. X. Ponnayya.
The Cuddapah Dist. Agri. Association Prize— { T. Venkatarama Reddi / C. Krishnamurthi / R. Suryanarayana.

After the distribution of the prizes, the meeting adjourned for tea at which the students and staff of the college and a select company of guests from the town included in which were Sir and Lady Vijayaraghavachari. During tea the guests were entertained at a fancy dress parade at which about 20 costumes most of which were very original and fascinating took part. A committee of judges awarded marks to the competitors and prizes were awarded to the best three. After tea, the party adjourned to the hall where a variety entertainment was arranged. The chief features of the entertainment were magic, a farce in two scenes depicting the way to heaven, vocal and instrumental music, a Telugu dialogue, humourous recitations, the singing of the College Ode specially composed for the occasion and the reading of the Hostel Chronicle'. All the items were thoroughly appreciated and they revealed wide and varied talents among the students. The sports prizes, College colours, prices for fancy dress competition and elocution contest and the trophies and prizes for the various tournaments were then given away by Mrs. Kamala Patel the wife of Dr. J. S. Patel, Oil Seeds Specialist. The winners were lustily cheered and with a vote of thanks by the Principal the pleasant function came to a close.

Literary activities. A meeting of the students' club was held on the 28th February when Mr. P. Parthasarathy of class iii spoke on "Fruit culture—its future." Another meeting was held on the 3rd March when Mr. G. N. Rangaswami Ayyangar delivered the valedictory address. The lecturer paid a glowing tribute to the College which was imparting education of a very high standard and utility. He exhorted the students on the spirit of service for which they were eminently suited by their training.

Week end tours: On the 25th and 26th the students of class iii went to the Nilgiris on a week end tour and visited the Government Botanical Gardens at Ootacamund. Sim's Park and Pomological station at Coonoor and saw the Burliyar and Kallar fruit stations on their way down the ghat. Another tour was arranged for the same class on the 13th March to Mettup layam. Both the tours were very enjoyable and instructive and much information was collected regarding agriculture of the hills.

Excursions. The residents of the colony were afforded several opportunities for sight seeing and relaxation from the routine monotony of the desk and field, by a number of excursions arranged during February and March. A party visited Valparai (Anamalais) and another went to Mettur to see the construction of the Dam in progress. Under the auspices of the Association of Economic Biologists a trip was arranged on the 19th March to visit the Siruvani water works.

Activities of the Upper Subordinate Officers' Association. 22 upper subordinates completed their probation on 19th August 1931, four days subsequent to the date of operation of the G. O. barring confirmations. The D. A. has been requested to condone the 4 days of uncomplete referred to and to confirm them in the old scales of pay.

The D. A. has also been requested to fill up vacancies now existing in the III and IV grades and to get a larger number of posts sanctioned in the higher grades

to relieve stagnation in the various grades. G. O. No. 542 of 8—4—32 bars the promotions where the grade, lower or higher, from or to which respectively promotions is sought is in a time scale of pay and the promotions to III and IV grades is limited by this rule. The Government have been approached accordingly to suitably modify the G. O.

The Association has reiterated the following resolution of the Madras Secretariat N. G. Officers Association and has submitted it to Government—

'That the Government be requested to be so good as to set apart the amount realised from the pay cut from 1—12—31 to 31—3—33 and constitute it into a separate fund for the purpose of granting gratuities to officers of the Provincial and Subordinate services who retire from service and to the families of officers who die in service and to work out a scheme for the purpose.'

Weather Review (FEBRUARY—1933)

RAINFALL DATA

Division	Station	Actual for month	Departure from normal	Total since January 1st	Division	Station	Actual for month	Departure from normal	Total since January 1st
Circars	Gopalpore	...	-0.7	0·5	South	Negapatam	0·6	...	1·8
	Berhampore *	...	...	0·6		Aduthurai *	0·8	+0·6	0·8
	Calingapatam	...	-0·5	...		Madura	...	-0·4	...
	Vizagapatam	...	-0·8	0·1		Pamban	0·2	-1·0	2·1
	Anakapalli *	...	-1·9	...		Palamkottah	1·1	+0·2	1·1
	Samalkota *	...	-0·5	...		Koilpatti *	...	-0·8	0·1
	Cocanada	...	-0·2	0·4					
	Maruteru *	...	...	...					
	Masulipatam	...	-0·4	...					
	Guntur *	...	-0·8	...	West Coast	Trivandrum	0·1	-0·5	0·1
						Cochin	1·0	+0·3	1·0
Ceded Dists.	Kurnool	0·3	+0·1	0·3		Pattambi *	...	-1·0	...
	Nandyal *	...	-0·2	...		Calicut	...	-0·1	...
	Anantapur	0·1	...	0·1		Taliparamba *	...	...	...
	Bellary	...	-0·1	...		Nileshwar *	...	-0·2	...
	Hagari *	0·2	+0·1	0·2		Kasargode *	...	-0·4	...
	Cuddapah	...	-0·1	...		Mangalore	...	...	...
Carnatic	Nellore	...	-0·1	...					
	Madras.	...	-0·3	...	Mysore and Coorg	Chitaldrug	0·3	+0·1	0·3
	Palakuppam *	...	-1·2	0·1		Bangalore	0·3	+0·2	0·3
	Palur *	0·1	-0·4	0·1		Mysore	0·4	+0·2	0·4
	Cuddalore	...	-0·8	...		Mercara	...	...	...
Central	Vellore	...	-0·3	...					
	Salem	...	-0·3	...	Hills.	Kodaikanal	1·2	-0·1	1·4
	Hosur Cattle Farm *	...	...	...		Coonoor	0·6	...	2·7
	Coimbatore	...	-0·4	...		Kallar *	0·4	-3·7	3·4
	Coimbatore Res. Inst. *	...	-0·5	...		Ootacamund *	0·1	-0·8	0·3
	Trichinopoly	...	-0·6	...		Nanjanad *	...	-0·6	0·3

Stations marked with an asterisk are stations of the Agricultural Dept.

General Weather. Weather was generally dry throughout the month, with a few scattered showers in the extreme south. Western disturbances traversing Upper

India had very little influence on the weather beyond causing an increase of cloud in the north. Rainfall was generally below the average except in Mysore and parts of Deccan and West Coast. Temperature was normal.

Weather Report for the Research Institute Observatory:

February 1933. Report No. 2/33.

Absolute maximum in shade	94·0°
Absolute minimum in shade	60·2°
Mean maximum in shade	91·5°
Departure from normal	+ 1·5°
Mean Minimum in shade	65·7°
Departure from normal	+ 0·4°
Total rainfall	nil.
Departure fom normal	—0·46"
Mean daily wind velocity	1·5 M. P. H.
Departure from normal	—2·0 M. P. H.
Mean humidity at 8 hours.	67·9 °/₀
Departure from normal	—3·4 °/₀
Total hours of bright sunshine	280·5
Mean daily hours of bright sunshine ...	10·0

General Weather: Weather was dry throughout the month. Day and night temperatures were slightly above mormal, while rainfall and humidity were below normal. Air movement was weak and for the greater part of the month, off the anticyclonic ridge of high pressure to the north. P. V. R. & T. S. L.

The Ramasastrulu—Munagala Prize, 1933.

1. The prize will be awarded in July 1933. 2. The prize will be in the form of a Medal and will be awarded to the member of the Union who submits the best account of original research or enquiry, carried out by him on any agricultural subject. 3. The subject matter shall not exceed in length twelve foolscap pages type-written on one side. 4. Intending competitors should notify the Secretary of the Madras Agricultural Students' Union not later than the 15th May the subject of the paper which they propose to submit and the paper should be sent in so as to reach the Secretary, Madras Agricultural Students' Union not later than the 1st June 1933, with a covering letter showing full name and address of the sender. The author's name should not be shown on the paper but should be entered under a nom de plume. 5. Four type-written copies of the essay should be sent in. 6. The name of the successful competitor will be announced and the prize awarded at the time of the Conference. 7. Papers submitted will become the property of the Union and the Union reserves to itself the right of publishing all or any of the papers. 8. All references in the paper to published books, reports or papers by other workers must be acknowledged. 9. Any further particulars may be obtained from the Secretary, Madras Agricultural Students' Union, Lawley Road, P. O., Coimbatore.

Departmental Notifications.

I Circle. D. Hanumantha Rao, A. D. Razole, l. a. p. on m. c. for 20 days from 20—2—33 to 11—3—33. A. Rammohan Rao, A. D. Rajahmundry extension of 1 a. p. on m. c. for 15 days in continuation of leave already granted. **II Circle** *Transfers*– J. Suryanarayana, F. M., A. R. S. Guntur to be A. D. Vinukonda. A. K. Annaswami Iyer, F. M., A. R. S. Guntur to be A. D. Kandukur. P. Gopalaratnam, Assistant in cotton, Cancelled his l. a. p. from 5th to 11th February. K. Ramanujachari, F. M. Guntur, l. a. p. for 15 days from 11—2—33 to 25—2—33. P. Satyanarayana, A. A. D. Kavali, l. a. p. on m. c. for 15 days from 27—2—33 **III Circle.** A. Krishnaswami Iyer, A. D. Koilkuntla, l. a. p. for three weeks from 6—2—33. K. Balaji Rao, A. A. D. Tadpadri is put in charge of the Vans from 30—1—33 for tour in the Bellary District. P. Subrahmaniam, A. D. Siruguppa, l. a. p. for 5 weeks from 10—2—33 A. Venkobacharlu A. A. D. after the expiry of leave is posted to Dronachelam with headquarters at Dronachelam and is granted l. a. p. for one month and two days from 29—1—33 on m. c. A. Krishnaswami, A. D Koilkuntla extension of 1 a. p. without m. c. for three weeks in continuation of leave already granted. **IV Circle.** A. Ramaswami Iyer, A. D. Villupuram extension of l. a. p. on m. c. for three months in continuation of leave already granted. R. Narasimhachari, A. A. D. l. a. p. for one month and 12 days from 1—3—33 with permission to suffix the holidays from 13th to 19th April 1933. **V Circle.** S. Mahadeva Iyer, A. D. Ariyalur. extension of l. a. p for one month in continuation of leave already granted. T. K. Balaji Rao, Assistant A. R. S. Aduturai, 1 a. p. for 30 days from 20—2—33. V. G. Dhanakoti Raju A. D. extension of l. a. p. for three months on m. c. in continuation of the leave already granted. **VI Circle.** K. Krishnan, A D. Tinnevelly l. a. p. on m. c for six weeks from 6—2—33. T. S. Venkataraman, A. D. Palni, l. a. p. for 4 months on m. c.. D. Shanmuga Sundaram is transferred to Palni. **VII Circle.** K. Achuthan Nambiar, A. D. in Mycology, l. a. p. for 2 months from 3—2—33. P. A. Kunhiraman Nambiar, A. A. D. Perintalmana l. a. p. for 14 days from 24—2—33 to 9—3—33. P. Narayanan Nambiar, A. A. D. l. a. p. for 13 days from 20—3—33. **Principal's Office.** C. Narasimhachari, Lecturer in Chemistry l. a. p. for 13 days from 13—2—33. S. N. Chandrasekhara Iyer, Assistant Lecturer in Botany l. a. p. for one month from 6—2—33. M. Rathnavelu, A. F. M. l. a. p. for 16 days from 3—3—33. **Paddy Section.** S. Dharmalingam Mudaliar, Assistant, extension of 1 a. p. for 16 days in continuation of leave already granted. S. Ramanujam, Assistant, l. a. p. for 9 days from 30—1—33. A. Chidambaram Pillai, F. M. l. a. p. from 21st February to 17th March with permission to avail 18th and 19th March being holidays. **G. A. C's Section.** M. Sundaram, Assistant l. a. p. for 6 weeks from 20—4—33. **D. A's Office Orders.** K. Govindan Nair, Chemistry Assistant, Research Institute, Coimbatore, leave on half average pay for one year from 26—1—33. K. Veerabhadra Rao, Assistant in Chemistry, will continue to officiate. M. Damodara Prabhu, Upper Subordinate, Agricultural section, will continue as Upper Subordinate, Agricultural section, in the temporary post sanctioned. D. Shanmuga Sundaram, will continue to officiate till further orders in the permanent post declared temporary. M. J. David appointed as offg. Assistant V grade in the scale of Rs. 85—5—120 in the Mycology section till 2nd April 1933. The following officiating appointments of Upper Subordinates in the Agricultural Section, V grade in the scale of Rs. 85—5—120 are ordered with effect from 1st March 1933. K. Kumaraswami Chetty to officiate as A. D. Vice S. Viravaradu Raju on other duty. S. Rajaratnam Chetty to officiate as A. D. Vice V. G. Dhanakoti Raju on leave. Muhamad Ali, to officiate as A. D. Vice A. Ramaswami Iyer, on leave. V. K. Appaji, to officiate as A. D. Vice P. S. Venkuswami Iyer on leave. L. Krishnan to officiate as F. M. A. R. S. Palur Vice V. Satagopa Iyangar on leave. H. Narahari Rao, A. F. M. Hosur, posted to

Samalkota for district work on poultry. P. Narayanan Nair, A. D. Dharapuram and M. Chinnaswami Naidu, A. D. Coimbatore, deputed for work connected with the irrigation experiments proposed under the Lower Bhavani Project from 20—3—33. Dr. C. T. George Asst. Ent. Section extension of leave without allowance for 1 month and 7 days from 11—3—33.

ADDITIONS TO THE LIBRARY
DECEMBER 1932.

A. Books.

1. Organisation of the wheat trade in the North-western Region—U. P. Prasad T. 1932. 2. An Economic Survey of Gijhi (Punjab Village Surveys No. 2) Narayan R. 1932. 3. Farm Accounts in the Punjab—1930-31. Kartar Singh S. 1932. 4. Cost of Milk Production at Lyalpur, Johnston, D. P. & Kartar Singh, S. 5. A. B. C. and X. Y. Z. of Bee Culture. Root, A. I & Root, E R., 1929.

B. Reports.

1. Madras Agri. Dept. Subordinate Officers Report for 1931-32. 2. Madras Agri. Dept, Administration Reports of the Agricultural Chemist, Entomologist, Mycologist, and Systematic Botanist for 1931-32. 3. Annual Report of the Madras Industries Department for 1931-32. 4. Season and Crop Report of the Madras Presidency for 1931-32. 5. Indian Weather Review—Annual Summary for 1931—Part A—Summary of Weather & Rainfall. 6. Annual Report of the Royal Agricultural Society of England for 1932. 7. Annual Report of the Florida Agri. Expt. Station for 1930-31.

C. Bulletins, Memoirs, etc.

1. Provisional Volume Tables and Diameter Growth Curve for Semal in the Central Provinces. *Ind. Forest Records Vol. XV Part V.* 2. Branch Smallwood Tables for Shorea robusta, Tectona grandis, Cedrus deodars, Pinus excelsa and P. longifolia. *Do. Vol. XV Part VI.* 3 Identification of Important Indian Sleeper Woods. *Ec. Series. Forest Bull No. 77-1932.* 4. Variations in the properties of the Cotton Fibre in relation to its position on the surface of the seed—(1) Fibre-length (2) Fibre-weight & (3) Fibre-strength. *Indian Central Cotton Committee Technological Bull Series B, No. 14.* 5. "Correction-slip" for the names of the more important trees and shrubs of the Madras Presidency. *Rept. from Mad. Forest College Magazine, Sept. 32.* 6. The Farmer's Guide to Agricultural Research in 1931. *Royal Agri. Soc. of England—Annual Publication, 1932.* 7. The Mitscherlich, Wiessmann & Neubauer Methods of Determining the Nutrient content of Soils. *Imp. Bur. of Soil Science Technical Commn. No, 25.* 8. A Simple System of Farm Book-keeping *Min. Agri. & Fish Bull. No. 58.* 9. Malayan Agricultural Statistics—1931. *S. S. & F. M. S. Dep. Agri. Econ. Ser. No. 1—1932.* 10. Preliminary List of Food Plants of Some Malayan Insects. *S. S. & F. M. S. Dep. Agri. Supp. to Bull. No. 38.* 11. Frozen Fruits and Their Utilization in Frozen Dairy Products. *Massachusetts A. E. S. Bull. 287 July 1932.*

D. Leaflets, Circulars, etc.

Ministry of Agriculture & Fisheries Leaflets. No. 144. Mutual Insurance of Live Stock-Cow & Pig Clubs. No. 146. The Valuation of Artificial Manures. No. 147. Phosphatic Fertilizers. *Cyprus Gazette—Agriculture Supplement No. 52.* Almond Growing in Cyprus.

E. Translations.

On the studies of drought resistance, morphological and physiological modifications and variations of yields for various soil-moisture contents in rice plant. By Onodera, J.

JANUARY 1933

A. Books.

1. Principles of Agrobiology or the Laws of Plant Growth in relation to Crop Production, Willcox, O. W. 1930. 2. The Soybeans. Piper, C. V. & Morse, W. J. 1923. 3. Land Drainage and Reclamation. Ayres, G. C & Scoates, D. 1928. 4. A Manual of Green Manuring. Ceyl. Agri. Dept. Pub. 1932. 5. Practical Hints on the making and Maintenance of Lawns in India. Sherrard-Smith W. 1931. 6. Practical Hints on Rose Culture in India. Sherrard-Smith W, 1932. 7. Practical Hints on Flower and Vegetable Culture in India. Sherrard-Smith. W, 1932. 8. The Agricultural Crisis-(2 Vols.) 1931. League of Nations Publication. 1931. 9. The Indian Peasant. Marquess of Linlithgow. 1932. 10. Industry and Trade. Marshall, A. 1927. 11. The Meaning of Money. Withers, H. 1930. 12. Hand Book of Commercial Geography. Chisholm, G. G. & Stamp, L, D, 1932. 13. Stocks and Shares. Withers, H. 1926. 14. Public Finance. Bastable C. F. 1927. 15. The Fundamentals of Statistics. Thurstone, L. L. 1928. 16. The Fundamental Principles of Taxation. Stamp, J. 1929. 17. Recent Advances in Cytology. Darlington, C. D. 1932. 18. Recent Advances in Plant Genetics. Sansome, S. W. & Philip (J) 1932. 19. Chromosome and Plant Breeding. Darlington, C. D. 1932. 20. International Address-Book of Botanists. Diels, S. & Merril, E. D. 1931. 21. Mendelism and Evolution, Ford, E. B. 1931. 22. Biology: An Introduction to the Study of Life. Fox, H. M. 1932. 23. The Scientific Basis of Evolution. Morgan, T. H. 1932. 24. The Causes of Evolution. Haldane, J. B. S. 1932. 25. A Revision of British Roses. Wolley-Dod, A. H. 1931. 26. Manual of Bacteriology, Muir, R and Ritchie, J. 1932. 27. Principles of Microbiology—2nd Edn. Waksman, S. A. 1931. 28. Ground Work of Biophysics. Wishart, G. W. 1931. 29. The Principles of Plant Biochemistry. Onslow, M. W. 1931. 30. Colloid Aspect of Food Chemistry and Technology, Clayton, W. 1932. 31. The Glycosides. Armstrong, E. F. & Armstrong, K. F. 1931. 32. Soil Characteristics: A Field and Laboratory Guide, Emerson, P. 1925. 33. Organic Syntheses Vol. XI. 1931. 34. Organic Syntheses Vol. XII. 1932. 35. Organic Chemistry for Advanced Students. Part I: Reactions. 1928. Part II. Structure. 1931. Part III. Synthesis. 1931. Cohem, J. B. 1931. 36. A Comprehensive Treatise on Inorganic & Theoretical Chemistry. Vol. XII. Mellor, J. W. 1932. 37. Breeding and Care of the Albino Rat for Research Purposes. Greenman, M J. & Duhring, F. L. 1931. 38. A Manual of Bee-keeping. Wedmore, E. B. 1932. 39. Fundamentals of Insect Life. Metcalf, C. L. & Flint, P. 1932. 40. Laboratory and Field Manual of Economic Entomology. Eyer, J. R. 1932. 41. Methods for the Study of the Internal Anatomy of Insects. Kennedy, C. H. 1932. 42. The Insect Menace. Howard, L. O. 1931. 43. Hydraulics. Lewitt, E. H. 1932. 44. Hydraulics for Engineers and Engineering Students. Lea, F. C. 1930. 45. Applied Mechanics. Low, D. A. 1931. 46. First Year Electrical Engineering. Bolton, D. J. 1929. 47. Accumulators: Charging Maintenance and Care. Camm, F. J. (N. D.)

B. Reports.

1. Annual Report of the Lalgudi Sivagnanam Co-operative Agricultural Society for 1931—32 (in Tamil). 2. Annual Report of Institute of Plant Industry, Indore for the year ending 30th June 1932. 3. Annual Report of S. S. & F. M. S. Agricultural Field Officers for 1931. 4. Annual Report of the Agricultural Department, Sierra Leone for the year 1931. 5. Annual Report of the Department of Agriculture, Tanganyika Territory for 1931. 6. Annual Report of the Agronomic Research Institute, Indochina for 1931—32 (in French).

C. Bulletins, Memoirs Etc.

1. Villagers' Calendar—1933 (Eng. Edn). *Madras. Agri. Dep. Pub.* 2 to 7. *Bombay Agri. Dept. Bulletins.* 162 of 1930 Papaya Cultivation in the Bombay Presidency

(Excluding Sind) 163 of 1930 Powdery Mildew of the Grape and Its Control in Bombay. 164 of 1930 Study in Intensive Farming Near Poona, under Canal Irrigation. 165 of 1930 The Frost of January 1929 and Its Damage to Crops of the Bombay Presidency. 166 of 1931 Bansi Wheat of the Bombay Deccan and its Improvement—Part I. 167 of 1931 Improvement of Manat Lands in the North Konkan. 8. Glossary of Terms Relating to Hides, Skins and Leather. *Ind. Trs. Jrl. 12—1—33 Supp.* 9. Proceedings of the Ninteenth Indian Science Congress—1932. 10. An Analysis of the Utilization of Irrigation Water in Typical Punjab Canals. Punjab Irr. Res. Lab. Mem. Vol. III—No. 1. 11 & 12. *Comm. Int. & Sta. Dep. Pub.* Indian Tea Statistics—1931. Indian Coal Statistics—1931. 13 & 14 *England Min. Agr. & Fish. Bull. No 59.* The Culling of Poultry. Asparagus. 15 & 16 *Imp. Agr. Bur. Exs. Coun. Pub.* List of Agricultural Research Workers in the British Empire—1931. List of Agricultural Research Workers in the Corrigenda & Addenda 1932. 17. Bibliography on the Breeding and Genetics of the Millets & Sorghums. *Eng Imp. Bur. Plant Gens. Pub Dec. 32.* 18 The Scope and Aims of the Imperial Bureau of Agrl. Parasitology. *Eng. Imp. Bur. Agrl. Parasitology Pub.* 19. Bibliography of Helminthology for 1931. *Eng. Imp. Bur.* Do. 20. An Examination of the Geology and Soils of an Area in the State of Perak. *S. S, & F. M. S. Agri. Dep. Sci. Ser. No. 10—1932.* 21. Further Notes on Leaf Curl of Tobacco in Southern Rhodesia. *Rhodesia Mini Mines & Agri Bull No. 861.* 22. (a) Tea Growing in Nyasaland. (b) Note on Tea Possibilities in the Area near Nkata Bay. *Nyasaland Agri. Dep. Bull. No 4 (N. S.)* 23 to 37. S. Aust. Agri. Dep. Bull. The Almond in South Australia. 220 Records of Some Departmental Work. 262 Dressmaking & Fancy Stitchery. 263. Vine Pruning in Non-Irrigated Districts. 264. Efficient Wheat Growing Methods. 265. A Classification of South Australian Wheat Varieties. 266. Some Points in the Handling of a Fat Lamb Flock on a Mallee Farm. 267. The Effect of Top-Dressing with Artificial Fertilizers on the Annual Yield, Botanical Composition, and Carrying Capacity of a Natural Pasture over a Period of Seven Years. 268. Financial Results of Two Years' Farming on Murray Mallee Farm No. I. 269 Some Observations on the Causes of the Surface Blemishes of Oranges in South Australia. 270. Malting Barley on the Farm and in the Malt House 271. Wheat Varieties in South Australia. 272. Mammitis, Milk Fever, & Contagious Abortion, 273. The Manufacture & Utilization of Silage. 274. The Dairying Industry. 275. 38. The Nature of Sword and water Suckers in the Banana. *United Fruit Co., Res. Dep. Bull. 22.* 39. Economic Utilization of Marginal Lands in Nicholas and Webster Counties, W. V. A. *Virginia A. E. S. Tech. Bull. 303.* 40 to 42. *Washington A. E. S. Bull.* Irrigation of Orchards by Sprinkling. 268. The Effect of Fertilizers on Crop Yields of Different Soils and on the Composition of Certain Crops. 274. A Plan for Adjusting Cash Rent to Changes in the Prices of Farm Products. 295. 43 & 44. *Cornell A. B. S. Bull.* Carbo-Hydrate and Nitrogen Metabolism in the Celery Plant as Related to Premature Seeding. 140. Relation of Daily Price to the Marketing of Hogs at Chicago. 534. 45 to 47. *Arkansas A. E. S. Bulletin.* Farm Standards of living in Faulkner County, Arkansas.279. Development of Agricultural Credit Corporations in Arkansas with State Aid in 1931. 281. Cotton Variety Tests. 282. 48. Who Pays for the Highways. Wisconsin A. E. S. Bull. 423 49 to 55. *Florida A. E. S. Bull.* An Economic Study of 249 Dairy Farms in Florida. 246. Variation in the Tung—Oil Tree. A Study of Range Cattle Management in Alachua County, Florida 248. Gray Leafspot, A New Disease of Tomatoes. 249. Some Major Celery Insects in Florida. 250. Control of the Celery Leaf-Tier in Florida. 251. The Melon Aphid. 252. 56 to 61 *Ohio A. E. S. Bull.* Preparation of Feeds for Dairy Cows 502. Ohio Agricultural Statistics for 1929–1930–1931 503. Marketing Canery Tomatoes on Grade in Ohio. 504. Factors Influencing the Dressing Percentage of Hogs. 505. The Influence of Laundering and Exposure to Light upon Some Wash Silks used for Outer Garments. 506. The Trend of Wheat Production in Ohio. 507, 62 to 66. *Michigan,*

A. E. S. The Various Effects of Frost Protectors on Tomato Plants. Tech. Bul. 124 On the Control of Caecal Coccidiosis in Chickens. Tech. Bull. 127. Activities of Churches in Town-Country Communities. Spl. Bull 226. Flies and Mosquitoes commonly found about Michigan Homes Cir. Bull. 144. The Virus Diseases of the Peach in Michigan. Cir. Bull 146. 67 to 73. *Illinois A. E. S. Bull.* A Study of the Framework of the Apple Tree and its Relation to Longevity. 376. Fertilizer Experiments with Ten Market-Garden Crops in Cook County, Illinois. 377. Alfalfa Wilt as Influenced by Soil Temperature and Soil Moisture. 378. Causes of Damage to Fruits and Vegetables during Shipment. 379. Price Differences between Four Hog Markets used by Illinois Stockmen. 380. Air Circulation and Temperature Conditions in Refrigerated Carloads of Fruit. 381. Crop Yields from Illinois Soil Experiment Fields in 1931. 382. Researches in the Flagellates of Belgium. (in Belgique). 1. Chrysomonadines. 2. Volvocales. *Musee Royal D'Histoire Naturelle De Belgique Memoir No 47.* 75. Odonata by F. C. Fraser (Coimbatore). ,, ,, ,, Supp.

D. Leaflets, Circulars, etc.

1. Plantation Crops: A Summary of Figures or Production & Trade relating to Sugar, Tea, Coffee, Spices, Cocoa, Rubber, Tobacco. *E. M. B. C/5.* 2 to 5 *Eng. Min. Agri. & Fish Adv. Lea.* Fruit Tree Red Spiders 10. Mutual Insurance of Live Stock—General. 143. General Live Stock Insurance. 149. Millepedes and Centipedes. 150. 6. Construction & Operation of Soils in the College of Agriculture. *Philippine A. E. S. Cir. No. 24.* 7. The University of Alberta. *Alberta Press Bull. Vol. 18-No. 2.* 8. The Silk Industry: Prospects of Cocoon Production, 1933. *Agri. Supp. to Cyprus Gaz. No. 2262 of 30—12—1932.*

E. Reprints.

1. Eradication of Tuberculosis from Cattle Herds. *Jrl. Roy. Agri. Soc. Eng Vol. 92-1931.* 2. Methods of Hand-Milking: A Comparison. *Jrl. Min. Agri. Eng. Sept. 32.* 3. The Effect of Season on the Reliability of the Percentage of Solids-Not-Fat in Milk, as Calculated by Formulae. *Univ. Reading Agri. Prog. Vol. IX. 1932.* 4 Effect of Carbon Dioxide Content of Storage Atmosphere on Carbohydrate Transformation in Certain Fruits & Vegetables. *Jrl. Agri. Res. Vol. 45, No. 8.*

F. Translations (*Imp. Bur. Plant Genetics*).

1. Full Translation of Pflanzenzuchtung Und Pflanzenphysiologie. *A. E. H. R. Boonstra.* 2. Full Translation of The Resistance of Rice Plants to Low Temperature and Cool Water in regard to its Fertility. *T. Fukuchi.*

BEST PLANTS & FRESH SEEDS

READY FOR SALE

Best Seeds to Grow in all climates	Rs.	A.
Salem Mango grafts, 3 years old dozen	9	0
Guava, Pomegranates, and Figs dozen	6	0
Pomaloe, Orange, Limes, etc., dozen	9	0
Roses and coloured crotons, dozen	6	4
English Vegetable and Flower seeds, good varieties, 20 sample packets, each set ...	2	0
Do. do. 10 sample packets, each set	1	0
Indian Vegetable seeds. 20 packets	2	0

Other sorts of plants and seeds are ready now.

Illustrated Catalogue free.

S. K. I. ABDUL RAHIMAN SAHIB.

Salem Nursery Gardens,

Tel. Address: 'NURSERY', SALEM SALEM